

CA1
7R85
-67R04A



DEPARTMENT
OF REGIONAL
ECONOMIC
EXPANSION

2nd ed Government
Publications

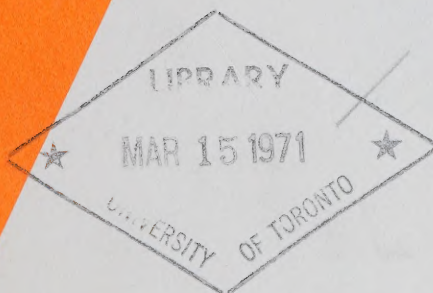


THE CANADA LAND INVENTORY

CLI



LAND CAPABILITY
CLASSIFICATION
FOR FORESTRY



The Canada Land Inventory
Report No. 4
1970



Digitized by the Internet Archive
in 2022 with funding from
University of Toronto

<https://archive.org/details/31761115557357>

CAI FR 85
70R04

THE CANADA LAND INVENTORY

Report No. 4—1967
Second Edition—1970

LAND CAPABILITY CLASSIFICATION FOR FORESTRY

Prepared for
The Canada Land Inventory
by R. J. McCormack

DEPARTMENT OF REGIONAL
ECONOMIC EXPANSION

Published under the authority of
The Minister of Regional Economic Expansion
Ottawa, 1970

Queen's Printer for Canada

Ottawa, 1970

Cat. No.: RE63-4/1970

CONTENTS

	Page
PART 1 - The Canada Land Inventory	
The Canada Land Inventory	1
The Land Classification System	2
The Basis of Classification	3
Capability Classes	4
Capability Subclasses	7
Guidelines for Mapping	8
PART 2 - Regional Class Descriptions	
British Columbia	
Capability Classes	10
Capability Subclasses	13
Alberta	
Capability Classes	15
Capability Subclasses	17
Manitoba and Saskatchewan	
Capability Classes	22
Ontario	
Capability Classes	31
Quebec	
Capability Classes	44
Capability Subclasses	46
Maritimes	
Capability Classes	51
Capability Subclasses	57
Newfoundland	
Capability Classes	61
Capability Subclasses	65

LIST OF TABLES

Table 1 - Ratings Related to Parent Materials and Drainage in Alberta	19
Table 2 - Summary of Capability Classes in Manitoba - Saskatchewan	26
Table 3 - Summary of Limitations in Manitoba - Saskatchewan	26
Table 4 - Limitations in Decreasing Order of Frequency in Manitoba - Saskatchewan	27
Table 5 - Summary of Capability Classes in Ontario	42
Table 6 - Dominant Limitations of Capability Classes in Ontario	43
Table 7 - Capability Classes and Major Subclasses in Quebec	47
Table 8 - Forestland Capability Classes and Subclasses in Quebec	50

PART 1

THE CANADA LAND INVENTORY

The Canada Land Inventory program is designed to provide a basis for land-use planning, particularly in areas where there is a requirement for the alternative use of marginal and sub-marginal agricultural land. Under this program, the land's capabilities for agriculture, wildlife, recreation and forestry is recorded, along with the land's present use, and certain population characteristics that are associated with this use. Thus, the method of classifying land for forestry must be comparable with other methods and be national in character.

The method described in this report has been developed co-operatively with the provinces. After initial discussions, a tentative classification was drawn up, tested in a series of pilot projects and further reviewed at regional meetings in 1964. Finally, in January 1965, the system was adopted at a national meeting at which all the provinces, universities, and federal regional offices were represented. It has since been reviewed and revised at two meetings of the National Committee on Forest Land, which is composed of delegates from all the agencies in Canada responsible for the classification and administration of large areas of land.

The national capability class descriptions have been modified for the different regions of Canada, and are based on the mapping experience of the first three years of the program. Regional descriptions are also incorporated in Part 2.

This classification is intended to function as a rating system and is designed to be interpreted from a variety of basic information. It should be viewed as a framework which can accommodate various levels and systems of information to produce a national rating of capability.

A series of coloured maps is being published at a scale of 1:250,000 and may be purchased from the Queen's Printer, Ottawa, as they become available.

The Land Classification System

All mineral and organic soils are classified in one of seven classes, based on an inherent ability to grow commercial timber. The best lands of Canada for commercial tree growth are in Class 1, while those in Class 7 cannot be expected to yield timber in commercial quantities; these represent the extremes. Because of unsuitable climate, there are no Class 1 lands in several regions of Canada, and in certain regions Class 2 areas are too small to be recorded at the chosen scales of mapping.

The three categories used in the system are: the capability class; the capability subclass; and the indicator species.

The Capability Class - When assigning land to a given class the environment of subsoil, soil, surface, local and regional climate as well as the characteristic tree species are all taken into account. The capability class, then, is an expression of all the environmental factors as they apply to tree growth.

The Capability Subclass - The factors which limit tree growth are shown as subclasses for all except Class 1. The kinds of limitation are important when they affect management, or can be corrected. The degree of limitation determines the class designation.

The Indicator Species - The tree species that can be expected to yield the volume associated with each class are shown as part of the symbol. Only indigenous species adapted to the region and land are shown.

The Basis of Classification

In an interpretive classification, the criteria and procedures must always be the same if the classification is to be uniform. The maps relating to this report have been prepared as follows.

- (1) The separation of the land surface into homogeneous units is on the basis of physical characteristics.
- (2) The assignment of each unit to a class is on the basis of all known or inferred information about the unit, including subsoil, soil profile, depth, moisture, fertility, landform, climate and vegetation.
- (3) Except for Class 1, the limitations are shown or implied. When the highest class in a region (other than Class 1) has no subclass associated with it, regional climate may be assumed to be the limiting factor. Different types of land may have the same capability rating, but for different reasons. The types of limitations are shown in the subclass.
- (4) Associated with each capability class is a *productivity range* based on the mean annual increment of the best species or group of species adapted to the site at, or near, rotation age. Productivity ranges are expressed in gross merchantable cubic-foot volume down to a minimum diameter of four inches. The productivity ranges are for "normal" or fully-stocked stands. Thinnings, bark and branch wood are not included.

- (5) Since only well-stocked stands are measured to indicate the capability class, the implication is that only good management produces such stands.
- (6) In a capability class, location, access, distance to markets, size of units, ownership, or present state are not considered. Present cover or production are only used as additional information for rating capability.
- (7) Classification is based on the natural state of the land without improvements such as fertilization, drainage or other amelioration. Improved forest management may change the productivity range. Also, if the limitations shown in the symbol are altered, there may be class changes. Since the classes are based on relatively permanent features, significant changes can only be brought about by costly and continuing practices.
- (8) Special crops such as Christmas trees are not considered.

Capability Classes

The regional reports on which most of the following descriptions are based are available for reference in Part 2 of this publication.

Class 1 - Lands having no important limitations to the growth of commercial forests

Soils are deep, permeable, of medium texture, moderately well-drained to imperfectly drained, have good water-holding capacity and are naturally high in fertility. Their topographic position is such that they frequently receive seepage and nutrients from adjacent areas. They are not subject to extremes of temperature or evapo-transpiration. Productivity is

usually greater than 111 cubic feet per acre per annum. When required, this class may be subdivided on the basis of productivity into Class 1 (111 to 130 cubic feet), Class 1a (131 to 150 cubic feet), Class 1b (151 to 170 cubic feet), Class 1c (171 to 190 cubic feet), Class 1d (191 to 210 cubic feet), and by 20-cubic-foot classes thereafter, as required.

Class 2 - Lands having slight limitations to the growth of commercial forests

Soils are deep, well-drained to moderately well-drained, of medium to fine texture and have good water-holding capacity. The most common limitations (all of a relatively slight nature) are: adverse climate, soil moisture deficiency, restricted rooting depth, somewhat low fertility, and the cumulative effects of several minor soil characteristics. Productivity is usually from 91 to 110 cubic feet per acre per annum.

Class 3 - Lands having moderate limitations to the growth of commercial forests

Soils may be deep to somewhat shallow, well-drained to imperfectly drained, of medium to fine texture with moderate to good water-holding capacity. They may be slightly low in fertility or suffer from periodic moisture imbalances. The most common limitations are: adverse climate, restricted rooting depth, moderate deficiency or excess of soil moisture, somewhat low fertility, impeded soil drainage, exposure (in maritime areas) and occasional inundation. Productivity is usually from 71 to 90 cubic feet per acre per annum.

Class 4 - Lands having moderately severe limitations to the growth of commercial forests

Soils may vary from deep to moderately shallow, from excessive through imperfect to poor drainage, from coarse through fine texture, from

good to poor water-holding capacity, from good to poor structure and from good to low natural fertility. The most common limitations are: deficiency or excess of soil moisture, adverse climate, restricted rooting depth, poor structure, excessive carbonates, exposure, or low fertility. Productivity is usually from 51 to 70 cubic feet per acre per annum.

Class 5 - Lands having severe limitations to the growth of commercial forests

Soils are frequently shallow to bedrock, stony, excessively or poorly drained, of coarse or fine texture, may have poor water-holding capacity and be low in natural fertility. The most common limitations (often in combination) are: deficiency or excess of soil moisture, shallowness to bedrock, adverse regional or local climate, low natural fertility, exposure particularly in maritime areas, excessive stoniness and high levels of carbonates. Productivity is usually from 31 to 50 cubic feet per acre per annum.

Class 6 - Lands having very severe limitations to the growth of commercial forests

The mineral soils are frequently shallow, stony, excessively drained, of coarse texture and low in fertility. Most of the land in this class is composed of poorly-drained organic soils. The most common limitations (frequently in combination) are: shallowness to bedrock, deficiency or excess of soil moisture, high levels of soluble salts, low natural fertility, exposure, inundation and stoniness.

Class 7 - Lands having severe limitations which preclude the growth of commercial forests

Mineral soils are usually extremely shallow to bedrock, subject to regular flooding, or contain toxic levels of soluble salts. Actively

eroding or extremely dry soils may also be placed in this class. Most of the land is very poorly drained organic soils. The most common limitations are: shallowness to bedrock, excessive soil moisture, frequent inundation, active erosion, toxic levels of soluble salts, and extremes of climate or exposure. Productivity is usually less than 10 cubic feet per acre per annum.

Capability Subclasses

Subclass symbols, when shown, always represent a limitation to growth and are used only when the limitations they represent affect the class level. When the limitations are advantageous or not severe enough to affect the class level, they are not shown.

Climate

Subclasses are used to denote a significant adverse departure from what is considered to be the median climate of the region, that is, a limitation as a result of local climate; adverse regional climate is expressed by the class level. The symbols used and the limitations they represent are as follows.

- A - drought or aridity as a result of climate.
- C - a combination of more than one climatic factor, or two or more features of climate that have significance.
- H - low temperatures - that is, too cold.
- U - exposure.

Soil Moisture

These subclasses denote that the soil moisture is less than optimum for the growth of commercial forests; but they do not include inundation. The symbols used and the limitations they represent are as follows.

- M - soil moisture deficiency.
- W - excess soil moisture.
- X - a pattern of "M" and "W" too intimately associated to map separately.
- Z - a pattern of wet organic soils and bedrock too intimately associated to map separately.

Permeability and Depth of Rooting Zone

These subclasses denote limitations of soil permeability, or physical limitations to rooting depth. The symbols used and the limitations they represent are as follows.

- D - physical restriction to rooting caused by dense or consolidated layers, other than bedrock.
- R - restriction of rooting zone by bedrock.
- Y - intimate pattern of shallowness and compaction, or other restricting layers.

Other Soil Factors

These subclasses denote factors of the soil which affect growth, either individually or in combination. The symbols used and the limitations they represent are as follows.

- E - actively eroding soils.
- F - low fertility.
- I - soils periodically inundated by streams or lakes.
- L - excessive levels of calcium.
- N - excessive levels of toxic elements, such as soluble salts.
- P - stoniness which affects forest density or growth.
- S - a combination of soil factors, none of which affect the class level by themselves, but which cumulatively lower the capability class.

Guidelines for Mapping

Complete guidelines have been prepared in a separate report which is available on request. In summary, a symbol consists of:

- (a) a capability class from 1 to 7;
- (b) a maximum of three subclasses, but generally not more than two, and;
- (c) a maximum of two indicator species.

Where necessary complexes are permitted, they may contain a maximum of three classes, but generally not more than two. The proportion of the area occupied by each class is indicated to the nearest 10 per cent.

Example 1

2M
rP

Indicates a capability class of 2 because of insufficient soil moisture. Red pine under good management can be expected to yield from 91 to 110 cubic feet per acre per annum on this area.

Example 2

7 3
3R 7
M W
wS bS

This complexed unit consists of 70 per cent Class 3 land with limitations of shallowness to bedrock and insufficient soil moisture. Well-managed white spruce can be expected to yield 71 to 90 cubic feet per acre per annum. Thirty per cent of the mapped unit consists of very wet soils which will grow less than 10 cubic feet per acre per annum of black spruce.

PART 2

REGIONAL CLASS DESCRIPTIONS

BRITISH COLUMBIA

D.S. Lacate¹, M.J. Romaine¹,
J.W.C. Arlidge² and G.G. Runka³

Capability Classes

Class 1

General - Soils are deep, permeable, of medium texture (silt loam, and fine sandy loam), and are moderately well-drained to imperfectly drained. Their topographic position is such that they commonly receive seepage water and nutrients from adjacent upland soils. They are not subject to extremes in temperature or evapo-transpiration. A lush, tall-shrub, herb-rich cover with many ferns is characteristic. In the coastal areas soils with moss vegetation can also be included.

Coast and Columbia Forest Regions - When required, this class may be subdivided on the basis of productivity into Class 1a (131 to 150 cubic feet), Class 1b (151 to 170 cubic feet), Class 1c (171 to 190 cubic feet), Class 1d (191 to 210 cubic feet) and Class 1e (211 to 230 cubic feet) in such areas as the Coast and Columbia Forest Regions. The environment in these areas is optimal for growth of the large western conifers, and the

¹Canada Department of Forestry and Rural Development, Victoria, B.C.

²Research Division, B.C. Forest Service, Victoria, B.C.

³Soils Division, B.C. Department of Agriculture, Kelowna, B.C.

forest productivity of the land is the highest in Canada. Preliminary surveys indicate that there is a general upward shift in the range of forest capability in these regions. Except for the obvious bedrock areas of Classes 6 and 7, the basic ratings at the lower end of the scale are in the Class 3 range. Capability ratings extend from Class 3 to Class 1e. Classes 1a and 1b are quite common; soils in Classes 1d or 1e are of limited size, but nevertheless are very important locally in areas where there is intensive management.

Class 2

Soils have slight limitations because of minor cumulative effects of adverse characteristics. The soils are deep moderately well to well-drained and of medium texture. The most common limitations are minor soil moisture deficiencies or slightly restricted rooting depth.

A tall-shrub, herb-rich vegetation, usually with ferns, is common on soils in this class.

Class 3

Soils are generally of medium texture and are associated with sloping or undulating topography. Coarse-textured soils (sands and gravels) can also be placed in this class if the water table is close to the rooting zone. Fine-textured soils (clay loam to clay) having limited rooting depth may be placed in this class if they are influenced by seepage water in the soil profile. As in Class 2, the most common limitations are moisture deficiencies and rooting-depth restrictions.

A shrub, herb-rich vegetation, with an increase in hygrophytic plants on the moister soils, is characteristic.

Class 4

Soils are limited because of deficiency of moisture caused by their texture, or because of their structure, or a combination of texture and structure which affects root penetration or rooting depth. These soils are usually well-drained and occur on level or undulating topography where there is no influence of internal seepage water in the rooting zone. There may also be limitations of excess moisture and shallowness to bedrock.

A low-shrub, herb and moss vegetation is typical on the well drained and shallow soils; where there is an excess of moisture, *Equisetum* and many hygrophytic plants are common.

Class 5

The limitations are commonly moisture deficiencies caused by the characteristics of the soils, or their topographic position, or alternatively an excess of soil moisture other than by inundation (poorly-drained soils). In addition, in steepland and mountainous areas, soils that are shallow to bedrock or subject to adverse temperatures and exposure are sometimes placed in this class.

On moisture-deficient soils, dwarf shrub, moss and lichen vegetation, or a dwarf shrub/grass cover are common; soils having excess moisture feature *Equisetum/Sphagnum* half-bogs (mesotrophic peats). Alpine dwarf shrubs and lichens characterize the exposed, higher-elevation soils.

Class 6

The limitations are easily identified. Such characteristics as shallow or very shallow soils over bedrock, coarse texture, exposure, poor drainage, or excessive levels of calcium, or soluble salts are the major

limitations. These soils are limited mainly by their depth, aspect and topographic position, rather than by their physical or chemical qualities.

On the shallow and moisture-deficient soils, dwarf shrubs and lichen types are common and in the grassland/forest fringe areas there is bunchgrass, sage and antelope brush cover. Treed bogs (oligotrophic peats) are characteristic of the poorly-drained soils.

Class 7

Included are extremely shallow soils over bedrock, poorly-drained organic soils, inundated mineral soils, actively eroding lands, soils high in toxic elements, stony and bouldery talus slopes, rapidly-drained soils, and soils subject to extremes of temperature and evapo-transpiration.

The vegetation is highly variable because of the extremes in the environment which are included in the class. The organic soils feature treeless bogs (*Carex* or *Sphagnum* or both); inundated soils feature stream-side shrubs and hygrophytic plants, and bedrock and eroded areas have scattered, depauperated vegetation and lichens.

Capability Subclasses

Climate

- A - drought or aridity caused by aspect, landform position or exposure, or combinations of these.
- H - accumulations of deep snow or a short, cool growing season, or both.

Soil Moisture

- M - soil moisture deficiencies attributable to soil and land characteristics.
- W - an excess of soil moisture, other than that caused by inundation.

Permeability and Depth of Rooting Zone

D - structure or permeability of the soil, either singly or in combination which restricts rooting depth.

R - the restriction of the rooting zone by bedrock.

Soil Fertility or Toxicity

L - excessive levels of calcium.

N - toxic elements, such as soluble salts.

Stoniness

P - indicates a limitation to growth because of stoniness.

Inundation

I - soils subject to inundation by streams or lakes.

Erosion

E - unstable land, that is, areas of active erosion, slumping, snowchutes and slide tracks.

Miscellaneous

S - cumulative effects of minor adverse inherent soil characteristics. (These minor adverse features may be soil fertility, or slight limitations caused by soil depth, moisture, or other characteristics. Used most often with Class 2.)

ALBERTA

H. Knight¹, J.A. Schalkwyk², J.R. Prokopchuk²,
N. Van Waas², E. Boyacioglu² and R. Pearson³

Capability Classes

The capability classes are based on field data originating from forest regions 18a and 19a (Rowe, 1959)⁴.

Class 1

Under the prevailing climate, Alberta forests seldom attain the productivity of this class. There are exceptions where an unusual combination of favourable factors result in the required high rate of growth. The areas found so far, however, are not sufficiently large to map.

Class 2

Again, the climate usually prevents the Alberta forests from attaining the required productivity. The areas that can be classified in Class 2 are larger than those in Class 1, but few are sufficiently large to map. Improved forest management in the form of rapid regeneration, proper stocking, timely release by thinning and pruning, and fertilization may help to compensate, but the climate always remains the dominant limitation.

¹Canada Department of Forestry and Rural Development, Calgary, Alberta.

²Alberta Forest Service, Edmonton, Alberta.

³Formerly of Alberta Forest Service, Edmonton, Alberta.

⁴Rowe, J.S. 1959. Forest Regions of Canada. Department of Northern Affairs and National Resources, Forestry Branch Bulletin 123.

Class 3

This class is considered to be the highest in the Province and as such is shown without limitation; a climatic limitation is implied. Forests grow on a variety of parent materials having a wide range of textures (Table 1). They are most consistently found on medium and fine-textured tills having a northern exposure, and on lowland sites under the influence of laterally-moving soil moisture.

Class 4

Most of the forest land in Alberta falls into this category. Stands grow on a variety of parent materials and over a wide range of soil textures. The most common limiting factor is the lack of soil moisture during the growing season.

Class 5

Class 5 land includes a variety of parent materials and a wide range of soil textures. Again the lack of available soil moisture is the most common limiting factor, often in combination with low temperatures which result in frost pockets or cold soils. Excessive exposure and steeply-sloping land are factors which, either by themselves or in combination, adversely affect growth. Restricted rooting depth caused by bedrock or soil density is common.

Class 6

These lands are generally not considered to be capable of producing commercial stands in Alberta. Forest growth is severely retarded, either by excessive soil moisture or by a deficiency of soil moisture, both

of which may be aggravated by one or more of the climatic or permeability limitations. Most of these lands consist of organic soils or deep sands.

Class 7

This type of land is so poor that it will not produce a forest stand. Extreme exposure, very shallow soils over bedrock, and deep, sandy soils result in moisture deficiencies which severely restrict forest growth. Excessive soil moisture associated with muskeg and poorly-drained, fine-textured soils are common limitations.

Capability Subclasses

Climate

Field data from forest region 18b (Rowe 1959) seems to indicate that growing conditions are not as favourable there as in forest regions further south. A separate climatic region may be required if the main cause of reduced growth can be determined. "Climatic Maps of the Prairie Provinces for Agriculture" (McKay, 1965)¹ are used as a guide to find whether climatic regions in Alberta can be related to tree growth. Since available soil moisture is a key factor in growth, precipitation during the year is important. The moisture index (Im) for the northern areas (latitude 58°+) is very close to semi-arid. Similarly, longer rotation ages in the Subalpine Forest Region would require a separate climatic region to explain lower maximum mean annual increments.

¹McKay, G.A. 1965. Climatic Maps of the Prairie Provinces for Agriculture. Climatological Study No. 1, Canada Department of Transport, Meteorological Branch, Toronto.

- H - Low lying areas (frequently with a high water table) are the only ones where "H" is used with Class 5 for white spruce. When the capability drops by one class, black spruce is always used with the limitation "W".
- U - Wind and sun exposure are recognized. Wind exposure occurs along river valleys in mountain gaps. Severity of the limitation has to be judged from the condition of the stands or individual trees as seen on aerial photographs. Probably it can only be recognized when productivity drops one class or more. Exposure to sun depends on the degree of slope, the aspect and the vegetative cover. Three directions are recognized, as shown by the numbers within the circle in the diagram on page 19, which is taken from the "East Slope Conservation Guide". It is not known how precise the directions are, but the following instructions show how the diagram is used.

No. 1 - Direction with up to 15 per cent slope and full tree cover would be responsible for a drop of one class. Lower stocking and a number of different slopes can result in a complete loss of productivity. The lack of vegetation is a limiting factor which aggravates the adverse effects of exposure.

No. 2 - Direction with up to 15 per cent slope and full tree cover is insufficient in itself to cause a drop of one class in productivity.

No. 3 - Direction is considered beneficial to tree growth.

- C - The limitation "C" is only used as a last resort and, if possible, the specific limitation is listed.

Soil Moisture

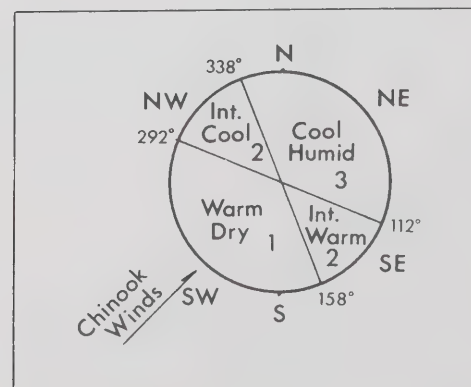
- M - Within a climatic region with sufficient precipitation, a deficiency of soil moisture can result from a combination of factors. The relevant factors are slope and texture, and to some extent structure of the soil. Most of the northern tills are fine textured with a good structure; therefore, the permeability of these tills is better than the texture seems to indicate. Extreme dryness is found most often in silty soils, apart from the obviously dry sandy or gravelly soils where lodgepole pine replaces white spruce as the index species. Class 5 is the highest class for pine on deep sand.
- W - The same procedure and the same factors are used here as for "M". This limitation applies to the circumstances under which black spruce replaces white spruce as the index species. It is used with white spruce in the lowest rating of Class 5; in ratings lower than Class 5 black spruce is substituted. The highest rating for black spruce is Class 6. Black spruce will grow at a better rate under drier conditions, but cannot compete with other species.

TABLE 1

RATINGS RELATED TO PARENT MATERIALS
AND DRAINAGE IN ALBERTA

Parent Materials	Rapidly-drained	Well-drained	Moderately-drained	Imperfectly-drained	Poorly-drained	Very Poorly-drained	Mean Annual Increment at 100 Years	
							Average	Maximum
Glacial Till	M	M	3	3	W	W	70	78
Alluvial/Till	M	3	3	W	W	W	70	81
Lacus-trine	M	M	M	3	W	W	70	89
Alluvial Lowland	M	3	3	3	W	W	70	--
Alluvial Terraces	M	M	3	W	W	W	60	74
Residual	M	R 4-M D	R 4-M D	W	W	W	64	70
Rough Broken	M	M	M	M	-	-	--	--

WIND AND SUN EXPOSURE DIAGRAM



This diagram is referred to and explained in section U, page 18.

- X - This subclass is used where soils of the same capability have limitations varying from "M" to "W" because of a recurring pattern of land. These opposing limitations are intimately associated and cannot be shown as separate types; for example, the short, steep hills of a hummocky, dead, ice moraine have a deficiency of moisture along the upper slopes and an excess of moisture along the lower slopes, while the capability of the two sites is similar.

Permeability and Depth of Rooting Zone

- D - This limitation is used mainly for solonetzic soils. Class 7 is used for solonetz, Class 6 for solodized solonetz and Class 4 and 5 for solod. These soils are slowly permeable and restrict rooting because of their compact B horizon and tendency to crack when dry. A permanently high water table often restricts rooting depth; but this is indicated by "W". Compaction of parent material, as found in basal tills, is not considered a limitation.
- R - Bedrock is a limitation when it comes within 18 to 24 inches of the surface. It can influence productivity by its angle of repose, ease of fracture and chemical and physical properties. Shale is more limiting than sandstone. So far, there is no evidence of large areas of bedrock that would significantly affect productivity.
- Y - Intimate patterns of shallowness and compaction seem highly unlikely in Alberta. The situation can be visualized when a solonetz has developed from shales which are close to the surface. In this case it would more likely be a continuous area rather than a pattern of the two.

Soil Fertility or Toxicity

- F - Used on coarse-textured parent materials, sands and coarse gravels to indicate a deficiency of available nutrients.
- L - None of the areas mapped have had this limitation.
- N - Areas naturally devoid of trees, or having slow growth which cannot easily be ascribed to any other cause, are investigated. When an excess of soluble salts is the cause, evidence is usually visible on aerial photographs.

Stoniness

- P - Stoniness has not been encountered to any extent. Colluvium talus cones and fans in the mountains, if they are sufficiently stable, are usually highly productive. The limitation will likely be applied only where there is a small matrix.

Inundation

- I - Floods can be damaging when they have sufficient volume, are frequent or last for a long time. Frequent flooding only causes damage when its volume and duration reach the required level; otherwise it may be beneficial. This limitation appears to be restricted to areas devoid of the index species, or where black spruce is invading Class 7 and possibly Class 6 lands. Examples of these areas are the active flood plains and emerging deltas along the lower Peace River and the mouth of the Athabasca River.

MANITOBA AND SASKATCHEWAN

S.C. Zoltai¹, J.P. Senyk²,
P. Gimbarzevsky³, and A. Kabzems²

Capability Classes

Broad, ecologically-significant regions were delineated to provide a description of forest capability classes (Map 1). The regions were based on the similarity of forest development and growth on similar sites. Thus they were based on the same criteria as the "Site Regions" established by Hills in Ontario⁴.

Various climatic, soil and vegetation maps were used in the initial location of the boundaries, and this information was evaluated and tested in the field. The field testing of the ecological significance of the boundaries, however, was incomplete and often sketchy. The boundaries, therefore, must be regarded as approximations.

The following descriptions of the forest capability classes were based on field work in areas 52-E, 52-L, 52-M, 62-H, 62-I, 63-B, 63-C, 63-D, 63-E, 63-F, and 73-H. Reconnaissance traverses were made in all but the far northern and southwestern areas. The descriptions, therefore, are not complete and are subject to improvement. In Table 2 these descriptions are summarized, and in Table 3 the limiting factors are presented for each

¹Canada Department of Forestry and Rural Development, Manitoba-Saskatchewan Region, Winnipeg, Man.

²Saskatchewan Department of Natural Resources, Forestry Branch, Prince Albert, Sask.

³Formerly Canada Department of Forestry and Rural Development, Manitoba-Saskatchewan Region, Winnipeg, Man.

⁴G.A. Hills, 1960. Regional Site Research. For. Chron. 36: 401-423.

site in the various regions. In Table 4 the limiting factors for each class are summarized.

Class 1

No lands in Manitoba and Saskatchewan are in this class.

Class 2

This class may have local representation in regions 5Sm, 5Sn, 4Sn, and 3Sm, but the areas are not large enough to map. Such sites are moist, recent alluvium in regions 4Sn and 3Sm, nutrient-rich moist clays in regions 5Sn and 5Sm, and moist sands enriched by telluric water in region 5Sm.

There are no factors limiting tree growth, apart from the effects of climate. Periodic inundation limits growth on alluvial sites.

Class 3

Regions 5Sm and 5Sn - Sites in this class are on level to very gently-sloping, moist clay, loam or sand over clay that neither lack nutrients nor have toxic levels of soluble salts.

Regions 4Sm, 4Sn and 3Sm - Sites in this class are on gently-sloping, moist alluvial clay or loam. The factors limiting growth are a seasonal excess or lack of soil moisture and periodic inundation.

Class 4

Region 5Sm - Sites in this class are on gently-sloping areas of fresh clay, fresh to moist loam, and moist sand and gravelly sand. The factors limiting growth are a variable moisture pattern on sand and gravels, and excessive carbonate content of loamy till and the density of the clay.

Region 5Sn - Sites in this class are on gently-sloping fresh and moist clays and loams. The factors limiting growth are a slight deficiency of moisture which becomes limiting in drought years, or a slight excess of moisture on the moist sites.

Regions 4Sm and 4Sn - Sites in this class are on gently-sloping, moderately-calcareous, fresh to moist clays and loams. The factor limiting growth is a periodic, slight excess or deficiency of moisture.

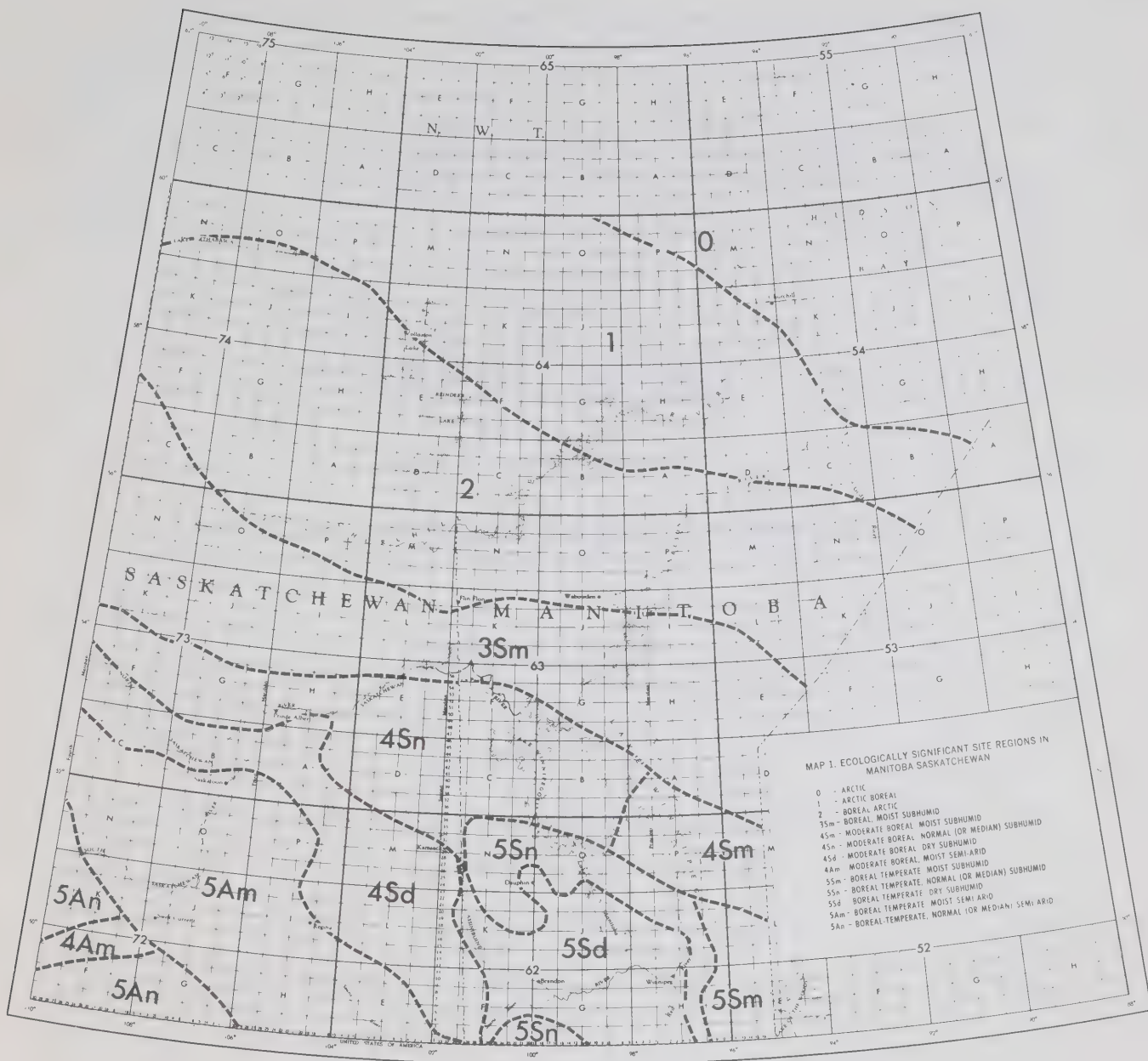
Region 3Sm - Sites in this class are on gently-sloping, moderately-calcareous, fresh clays and loams. The factor limiting growth is a seasonal lack of moisture.

Class 5

Region 5Sm - Sites in this class are on wet clays, loams, silts or sands on level or depressional areas, on dry to fresh sand or gravelly sand in flats or on rolling hills, on fresh to moist shallow, sandy loam over bedrock on gently to moderately-rolling relief, and on gently-sloping, fresh, highly-calcareous loam. The factors limiting growth are an excess of soil moisture on wet sites, a lack of soil moisture on the dry sands, a restriction of rooting by bedrock and a lack of nutrients in shallow soils, and toxic levels of calcium carbonate on some loams.

Region 5Sn - Sites in this class are on gently-sloping, moist to fresh, very highly-calcareous loam, and on fresh to moist clay and sand. The factors limiting growth are toxic levels of calcium carbonate and a regional tendency towards grasslands on the clays.

Region 5Sd - Sites in this class are on gently-sloping to level, moist clays, loams and sands. No factor other than climate limits tree growth.



Region 4Sm - Sites in this class include fresh clays, loams and sandy loam on gently-sloping relief, fresh, shallow, sandy loam over bed-rock on moderately-sloping areas, and dry sand. The factors limiting growth are a slight excess or lack of soil moisture, toxic levels of calcium carbonate on some loams, a restriction of rooting by bedrock, and a lack of mineral nutrients in some shallow soils.

TABLE 2. SUMMARY OF CAPABILITY CLASSES IN MANITOBA-SASKATCHEWAN

Region	Clay				Loam				Sandy Loam				Sand				Organic Matter	Rock
	Dry	Fresh	Moist	Wet	Dry	Fresh	Moist	Wet	Dry	Fresh	Moist	Wet	Dry	Fresh	Moist	Wet	Wet	Dry
5 Sm	—	4	(2)3	5	—	4,5	3,4	5	—	4	3,4	5	5	5	(2)3,4	5	6,7	7
5 Sn	—	4,5	(2)3,4	6	—	4,5	3,4,5	6	—	—	3	6	6	5	3,5	6	6,7	—
5 Sd	7	6,7	5	7	7	6,7	5	7	7	7	5	7	6,7	6,7	5	7	7	—
5 Am	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	—
5 An	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	—
4 Sm	—	5	3,4	6	—	4	3,4,5	6	—	5	4	6	5	4	4	6	6,7	7
4 Sn	6	(3)5	3,4,5	6	6	3,4	(2)3,4,5	6	5,6	5	4,5	6,7	6	5	5	6	6,7	—
4 Sd	7	7	5	7	7	6	5,6	7	7	6	6(5)	7	7	7	6	7	7	—
4 Am	6	5	5	7	6	5(4)	5(4)	7	6	5	5	7	5,6	5	5,6	7	7	—
3 Sm	—	(3)4,5	5,4	6	5	(3)4	5	6	5	5(4)	5(4)	6	6	5	6(5)	6	6,7	7
2	—	5	6,7	7	—	5	6,7	7	—	5	7,6	7	6	5	7	7	7	7
1	—	(6)7	7	7	—	(6)7	7	7	—	(6)7	7	7	7	(6)7	7	7	7	7
0	—	7	7	7	—	7	7	7	—	7	7	7	7	7	7	7	7	7

TABLE 3. SUMMARY OF LIMITATIONS IN MANITOBA-SASKATCHEWAN

Region	Clay				Loam				Sandy Loam				Sand				Organic Matter	Rock
	Dry	Fresh	Moist	Wet	Dry	Fresh	Moist	Wet	Dry	Fresh	Moist	Wet	Dry	Fresh	Moist	Wet	Wet	Dry
5 Sm	—	M D	W,I D	W	—	L M	L W	W,I	—	L M R	L W R	W	M	M	X	W	W	R M
5 Sn	—	M	W,I	W N	—	L M	L W	W,I N	—	—	—	—	M	M	L,W	W	W	—
5 Sd	M	M	—	W N	M	M	—	W N	M	M	—	W N	M	M	W	W	W	—
5 Am	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5 An	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4 Sm	—	M	W,I	W	—	M	W,I	W	M R,F	M R,F	—	W	M	—	—	W	W	R M
4 Sn	—	M	W,I	W	—	L M	L,I W	W	—	—	—	—	M F	—	—	W	W	—
4 Sd	M	M	W	W N	M	M	W	W N	M	M	W	W N	M	M	W	W	W	—
4 Am	M	—	—	W	M	—	—	W	—	—	—	—	—	—	—	W	W	—
3 Sm	—	M,I	W	W	M R	M,I R	W	W	M R	M R	W	—	M	—	—	W	W	R M
2	—	—	W	W	—	—	W,F	W	R,F	—	W	W	M,F	—	W	W	W	R,M
1	—	—	W D	W D	—	—	W D	W D	—	—	W D	W D	—	—	W D	W D	W D	—
0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Region 4Sn - Sites in this class are on gently to moderately-rolling areas of fresh to moist clays, on moist, very highly-calcareous loam, and on fresh to dry sands having an adequate nutrient supply. The factors limiting growth are an excess or lack of soil moisture, and toxic levels of carbonates on some loams.

TABLE 4
LIMITATIONS IN DECREASING ORDER OF FREQUENCY
IN MANITOBA-SASKATCHEWAN

Class	Limitations
2	None
3	W, I
4	W, M, L, D, I
5	W, M, L, R, F, I
6	W, M, R, N, F, I
7	W, M, R, D, N

Region 4Sd - Sites in this class are on moist, heavy loams and clay loams. The factor limiting growth is a seasonal excess of soil moisture.

Region 4Am - Sites in this class are on gently to moderately-sloping, fresh to moist clays, loams and gravelly sands. No factor other than climate limits tree growth.

Region 3Sm - Sites in this class are on gently-sloping, fresh sandy loams and shallow loam and sandy loam over bedrock, and dry sand, and on moist clay, loam and sandy loam soils. The factors limiting growth are a periodic excess or lack of moisture, and a restriction of rooting by bedrock.

Region 2 - Sites in this class are on moist, fresh, deep soils. No factor other than climate limits tree growth.

Region 1 - Sites in this class are local, fresh sites near rivers and lakes. No factor other than climate limits growth.

Class 6

Region 5Sm - Sites in this class are on level deposits of wet, shallow to deep, organic material. The factor limiting growth is an excess of soil moisture.

Region 5Sn - Sites in this class are on level deposits of wet, shallow to deep, organic matter, on all wet mineral soils, and on gently-sloping, dry, sandy gravel. The factors limiting growth are an excess of soil moisture, a lack of soil moisture, and toxic levels of salts.

Region 5Sd - Sites in this class are on gently to moderately-sloping, fresh clays and loams, and on fresh to dry sands. The factor limiting growth is a lack of soil moisture.

Region 4Sm - Sites in this class are on level, shallow to deep deposits of wet, organic soils, on all wet, mineral soils, and on gently to moderately-sloping shallow, dry, sandy loam over bedrock. The factors limiting growth are an excess or lack of soil moisture, a restriction of rooting by bedrock, and a lack of nutrients.

Region 4Sn - Sites in this class are on gently to moderately-sloping, dry sands lacking mineral nutrients, on wet clays, loams, sands and organic materials on gently-sloping areas. The factors limiting growth are an excess or lack of soil moisture, and a deficiency of nutrients.

Region 4Sd - Sites in this class are on moist loams and sands on level to gently-sloping areas. The factors limiting growth are an excess or lack of soil moisture.

Region 4Am - Sites in this class are on dry clays and loams on gently to moderate slopes. The factor limiting growth is a lack of soil moisture.

Region 3Sm - Sites in this class are on gently-sloping to level wet clays, loams and sands, on wet, shallow to deep, organic matter, and on gently to moderately-sloping, dry loam over bedrock. The factors limiting growth are an excess or lack of soil moisture and a restriction of rooting by bedrock.

Region 2 - Sites in this class are on gently-sloping, moist loams and on dry sands. The factors limiting growth are an excess or lack of moisture, low fertility and a restriction of rooting by bedrock.

Class 7

Regions 5Sm, 4Sm, 3Sm - Sites in this class are on wet, deep deposits of organic matter, and on bare bedrock areas. The factors limiting growth are an excess or lack of soil moisture, and a limited rooting zone.

Regions 5Sn and 4Sn - Sites in this class are on wet, shallow to deep, organic matter. The factor limiting growth is an excess of soil moisture.

Regions 5Sd and 4Sd - Sites in this class are on fresh to dry and wet clays, loams and sands of variable relief, and on wet, shallow to deep, organic materials. The factors limiting growth are an excess or lack of soil moisture, and toxic levels of soluble salts.

Regions 5Am and 5An - All sites are in this class. The regional climate limits forest growth.

Region 4Am - Sites in this class are on wet areas of all soil materials. The factor limiting growth is an excess of soil moisture.

Region 2 - Sites in this class are on moist clays, sandy loams and sands, and on all wet sites. The factor limiting growth is an excess of soil moisture.

Region 1 - Sites in this class are on all soil materials, except those located near rivers and lakes. The factors limiting growth are an excess of soil moisture and permanently-frozen soil.

Region 0 - Sites in this class are on all soil materials. The climate limits tree growth.

ONTARIO

A.N. Boissonneau¹, J.R.M. Williams¹, S.C. Zoltai²,
G.N. Crombie¹, H.A. McNeely¹, and D. Bates¹

CAPABILITY CLASSES

The forest site regions of Ontario are used as a framework for the description of the forest capability classes³. These regions have been defined by noting the variations in vegetation upon similar landforms which were located at various places throughout the province. When a given landform is examined at various locations over broad areas, all the physiographic features which have a significant influence on forest development, except climate, remain relatively constant. Thus the only feature associated with observed changes in forest development on a given landform is climatic change. Site region boundaries were drawn, as indicated in Map 1, so that within each region there is a core area where the same vegetation development occurs on similar landforms and a peripheral area where, because changes of landform-vegetation relationships are gradual, the vegetation development is dominantly the same as that of similar landforms located in the core area, but where vegetation development characteristic of similar landforms located in the core areas of adjoining regions will also be found.

In the descriptions which follow, space limitations necessitate a choice of a very limited number of representative physiographic site types

¹Ontario Department of Lands and Forests, Richmond Hill.

²Canada Department of Forestry and Rural Development, Winnipeg; formerly Ontario Department of Lands and Forests.

³G.A. Hills, 1960. Regional Site Research For. Chron. 36:401-423.

Humid Eastern Ontario

- | | |
|----|---------------|
| 1E | Hudson Bay |
| 2E | James Bay |
| 3E | Lake Abitibi |
| 4E | Lake Timagami |
| 5E | Georgian Bay |
| 6E | Lake Simcoe |
| 7E | Lake Erie |

Humid Western Ontario

- Big Trout Lake
L. Nipigon
Pigeon River

Subhumid Western Ontario

- 3S Lake St Joseph
4S Wabigoon Lake
5S Lake of the Woods

BOUNDARIES OF REGIONS

REGIONS BASED ON EFFECTIVE TEMPERATURE

— Boundaries of 'thermal' site regions

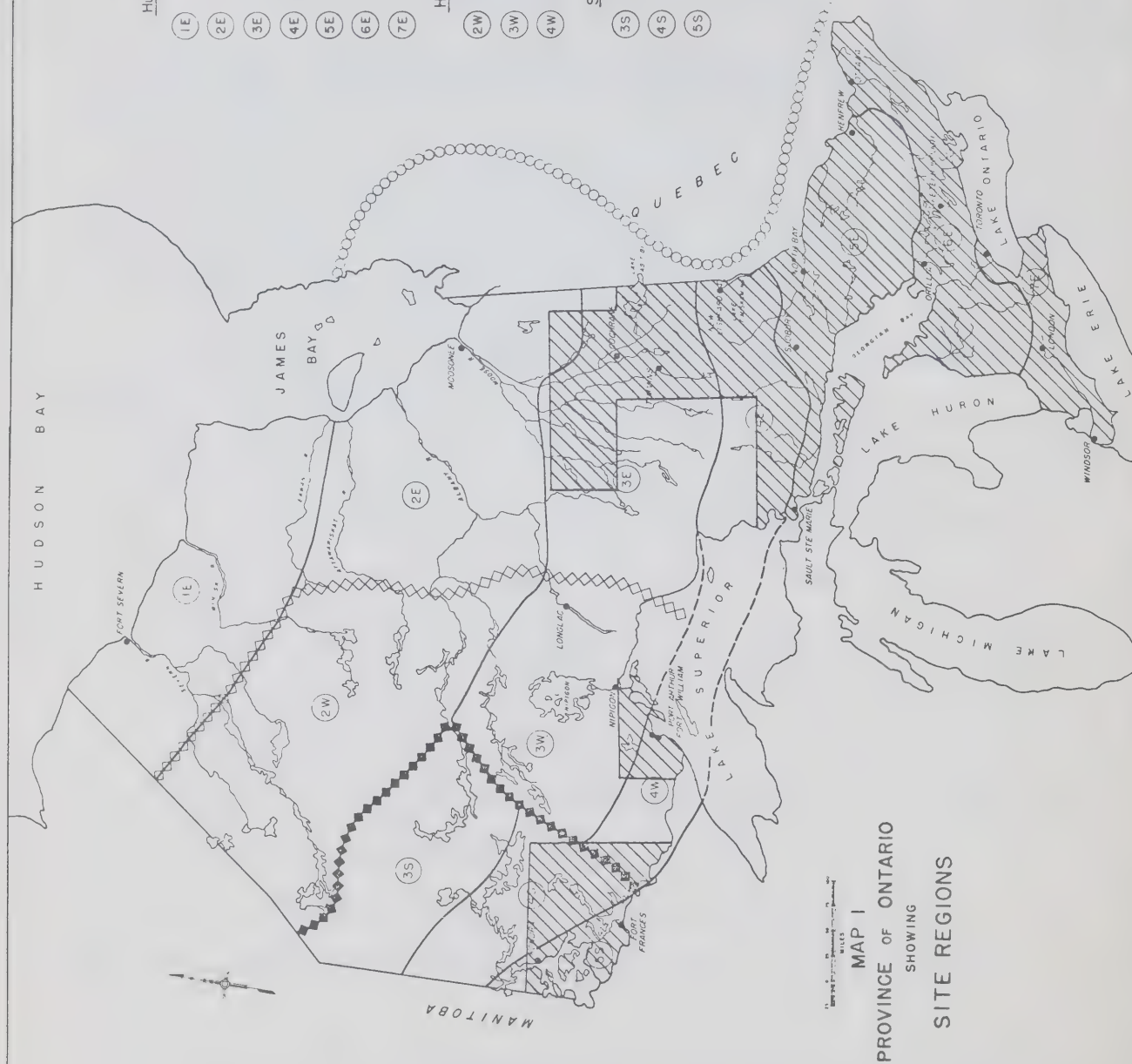
REGIONS BASED ON EFFECTIVE HUMIDITY

- ◆◆◆ Eastern boundary of Subhumid
◇◇◇ Eastern boundary of Humid Western
(driest humid)
○○○ Eastern boundary of Humid Eastern
(medium humid)
and western boundary of the wettest
humid (not the perhumid)

ARDA Area



SITE SECTION
DIVISION OF RESEARCH
DEPARTMENT OF LANDS AND FORESTS
MARCH - 1964



from the wide range of types which are representative of each class in each forest site region⁴. Table 5 presents a wider range of this physiographic site spectrum in each region and Table 6 indicates the dominant limitations to forest production which are associated with the site types which are summarized in Table 5.

Class 1

Site Region 7E - Class 1 in this region includes a fairly wide range of better sites, including deep soils of fine sand, sandy loam, loam and good structure clay-loam texture, which have adequate profile depth and adequate supplies of moisture and nutrients⁵. Soils with slight deficiency of moisture or nutrients may fall in this class. They have also normal or slightly warmer than normal local climates. The stable forest cover on these sites is maple-beech, with some oak and hickory.

Site Region 6E - The range of sites falling in Class 1 is somewhat more restricted than in Region 7E, and includes only the best soils,

⁴Representative physiographic site types of Region 2E are not described in this report because they are similar to those of Region 3E. The main difference of vegetation development in these two regions is that saturated, deep peat sites have developed on about 80 per cent of the area of Region 2E and on about 20 per cent of Region 3E.

⁵D.V. Love and J.R.M. Williams, 1966. The Economics of Plantation Forestry in Southern Ontario. Prelim. Mimeo Rept. The authors calculated gross total yields to age 50 to be in excess of 200 cu.ft. per acre per year in red pine plantations growing on the best sites of Site Regions 6E and 7E. While there is no firm basis for converting this yield to M.A.I. of merchantable wood at rotation age, it is reasonable to expect that these sites are capable of attaining the level of productivity assumed for Class 1. Thus where it is feasible to grow red pine on these sites (e.g. cleared lands where hardwood competition has been eliminated for at least one forest rotation) the yield at rotation age will be at least 111 cu.ft. per acre. Where hardwoods must be grown the potential productivity of these sites is more problematical. Studies are planned to investigate the yield of hardwoods on these sites.

with normal, or warmer than normal local climate. Thus a narrow range of texture - sandy loam, loam and very good structure clay loam, in soils having optimum moisture and nutrient supplies, is admitted to this class. The stable forest on these sites is maple-beech.

Other Regions - Sites falling in this class are rare in Site Region 5E and absent elsewhere because of limitations imposed by climate.

Class 2

Site Region 7E - This class includes sites with some slight soil or local climate deficiency. Thus, somewhat dry, deep sands; moist sands and well drained clays of fair structure are included. The stable forest types associated with these are oak with some white pine on drier sands, oak-hickory-soft maple on moist and heavier soils.

Site Region 6E - This class embraces soils with very slight limitations, for example, loam, sandy loam and good structure clay loam with a slight nutrient deficiency and a slight excess or deficiency of moisture. A clay till with moderately good structure, good profile depth, and no other limitations, may also fall within this class. Many sands with underlying fine layers that hold supplementary moisture fall in this class. The stable forest types on the well-drained sites are largely sugar maple-beech, those on the moist sites are soft maple-elm, though the latter is currently being decimated.

Site Region 5E - Common physiographic site types of this class are deep soil materials of a loam or silty, fine sand texture with a balanced nutrient supply for tree crops. The moisture regime of these sites is fresh and the silty fine sand sites are periodically enriched with

telluric water. The stable forest type commonly associated with these physiographic site types is a maple forest, with a scattering of white pine and hemlock on sites with an ecoclimate which is normal for Region 5E, and a hard maple-beech forest with a scattering of hemlock on sites with an ecoclimate which is warmer than normal for this region.

Site Region 5S - Physiographic site types in this class are deep soil materials of a good-structured clay, a loam or silty, fine sand texture with a good balance of nutrients for tree crops and with soil profiles indicating considerable mixing of organic material within the upper soil horizons. The moisture regime of these sites is moist and the silty, fine sand sites are periodically enriched with telluric water. The stable forest type commonly associated with these sites in this region is trembling aspen-white spruce.

Class 3

Site Region 7E - Extensive areas of clay with internal drainage and rooting restricted by poor structure fall in this class, as do some extensive areas of moist sand. The stable stand associated with the well-drained sites is maple-beech-oak-hickory and soft maple stands are associated with the imperfectly drained sites.

Site Region 6E - This class includes extensive areas of deep, dry, medium sand; and areas of moist sand, where limitations are imposed by a combination of limited fertility and either deficiency or excess of soil moisture. The stable types associated with these are hard maple on dry sites, soft maple on moist.

Site Region 5E - A physiographic site type of this class is a deep loam material with a low base petrography and a moist moisture regime and is usually located on a lower slope. The soil texture provides good internal drainage and the petrography status provides a moderately good, balanced supply of nutrients for tree crops. The ecoclimate associated with this site type is usually the normal ecoclimate of Region 5E and the stable forest type associated with this site is hard maple-yellow birch with a scattering of hemlock and white pine.

Site Region 4E - A physiographic site type of this class is a deep soil material of a loam or silty, fine sand texture and low base petrography which provides a moderately good, balanced supply of nutrients for tree crops. The moisture regime associated with this site type is fresh and the stable forest type is balsam fir-white spruce-white pine.

Site Regions 5S and 4W - A physiographic site type of this class is a deep, moist clay, loam or silty sand material with a low base petrography. This physiographic site type is similar in all respects to the type described for Region 5S in Class 2 except that these sites are not enriched with telluric water and there is only slight mixing of organic and mineral material in the upper soil layers.

Site Region 4S - A physiographic site type of this class is a deep soil material of a clay or loam texture with a good, balanced supply of nutrients for tree crops. The moisture regime associated with this type is moist and the site is periodically enriched with telluric water. A stable forest type of white spruce-trembling aspen is associated with this site type.

Class 4

Site Region 7E - Sites in this class include some extensive very poorly drained mucks, as well as some lesser areas of very shallow soil over limestone bedrock. The forest type associated with the muck areas is mainly soft maple, with some cottonwood.

Site Region 6E - Sites in this region include shallow, fine sand or sandy loam (1.5 to 4 ft) over somewhat broken limestone bedrock, having a somewhat fresh moisture regime, and a fairly well-balanced nutrient supply. The stable forest type on this site is hard maple with some white pine.

Site Region 5E - A physiographic site type of this class is a shallow soil material of a silty, fine sand texture and a very low base petrography which provides a moderately poor supply of nutrients for tree crops. The moisture regime associated with this site type is dry to fresh and its situation is usually upon middle and upper slopes. The stable forest type associated with this site type is hard maple with a scattering of white pine and hemlock.

Site Region 4E - A physiographic site type of this class is a deep, silty, fine sand with a fairly good balanced supply of nutrients for tree crops. The moisture regime associated with this site type is moist and the associated ecoclimate is usually the normal ecoclimate for Site Region 4E. A stable forest type of balsam fir-white spruce-white pine is usually associated with this site type.

Site Region 3E - A physiographic site type of this class is a deep, good structured clay with a moderate lime petrography which provides a moderately good, balanced supply of nutrients for tree crops. The

moisture regime associated with this site type is fresh and the associated ecoclimate is usually the normal ecoclimate for Region 3E. A stable forest type of trembling aspen-balsam fir-white spruce is usually associated with this site. Comparable production of jack pine could be obtained on sites of this type which were severely disturbed by fire so that the competition of trembling aspen, balsam fir and white spruce has been eliminated for one forest rotation.

Site Regions 5S and 4W - A physiographic site type of this class is a deep clay or loam soil material with a good, balanced supply of nutrients. The moisture regime associated with these sites is fresh. A stable forest of trembling aspen-white spruce is normally associated with these sites, hence though comparable yields of white pine could be obtained from these site types, the production of white pine would only be feasible on cleared land where competition of aspen and white spruce has been eliminated.

Site Region 3W - A physiographic site type of this class is a deep soil material of clay texture with a good, balanced supply of nutrients for tree crops. The moisture regime associated with this site type is fresh. A stable forest of trembling aspen-white spruce-black spruce is associated with this site type.

Class 5

Site Region 7E - Sites in this class include some very shallow soils of varying texture over limestone, as well as some very wet muck areas.

Site Region 6E - Sites in this class include very shallow (8 to 18 inches) fine materials over limestone bedrock, as well as very numerous small areas of poorly drained, well decomposed mucks.

Site Region 5E - A physiographic site type of this class is a deep soil material of a coarse and medium sand texture and very low base petrography which provide a moderately poor supply of nutrients for tree crops. The moisture regime associated with this site type is dry and the associated ecoclimate is frequently warmer than the normal ecoclimate of Region 5E. A stable forest of red pine, jack pine or white pine is associated with this site type.

Site Region 4E - A physiographic site type in this class is a deep soil material of a coarse and medium sand texture and a moderately poor supply of nutrients for tree crops. The moisture regime associated with this site type is moist and the stable forest type is balsam fir-white spruce.

Site Region 3E - A physiographic site type of this class is a deep soil material of a fine sand texture with a moderately poor supply of nutrients for tree crops. The moisture regime associated with this site type is dry. Stable forest types associated with this site type are jack pine or jack pine-white birch.

Site Region 5S - A physiographic site type of this class is a deep soil material of clay texture with a very high carbonate content where the excessive lime limits the availability of other nutrients. The moisture regime associated with this site is fresh and the stable forest type associated with this site is trembling aspen-white spruce.

Site Regions 4S and 4W - A physiographic site type of this class is a deep soil material of a silty, fine sand texture and a very low base petrography which provides a moderately poor supply of nutrients for tree crops. The moisture regime associated with this site is dry and the associated stable forest type is usually jack pine.

Site Region 3W - A physiographic site type of this class is a deep soil material of a clay texture and very high lime petrography where excessive lime limits the availability of other nutrients so that the overall supply of nutrients for tree crops is poor. The moisture regime associated with this site is fresh and the associated stable vegetation is a trembling aspen-white spruce.

Class 6

Site Regions 7E and 6E - Sites in this class include very shallow (3 to 12 inches) soil materials over limestone bedrock, giving severe limitations of rooting depth, moisture and nutrients. An open stand of poor hard maple and red oak is associated with this site.

Site Region 5E - A physiographic site type of this class is a deep soil material of a coarse and medium sand texture with a moderately poor supply of nutrients for tree crops. The moisture regime associated with this site is wet and the associated stable forest type is usually black spruce-balsam fir.

Site Region 4E - A physiographic site type of this class is a deep soil material of a silty, fine sand texture with a moderately good, balanced supply of nutrients. The moisture regime associated with this site is wet and the associated stable forest type is black spruce.

Site Region 3E - A physiographic site type of this class is a deep soil material of a clay texture and a somewhat poor supply of nutrients because of excessive lime in the mineral soil and because of an accumulation of poorly decomposed peat. The moisture regime associated with this site is wet and a moderate depth (up to 3 ft.) of peat has accumulated on this site. A stable forest type of black spruce is associated with this site.

Site Regions 5S and 4W - A physiographic site type of this class is a shallow, silty, fine sand over bedrock. The moisture regime associated with this site type is dry. The stable forest type associated with this type is jack pine.

Site Regions 4S and 3W - A physiographic site type of this class is a shallow peat site (7 inches to 3 feet in depth) over any inorganic soil material. The moisture regime associated with this site is wet and the associated stable forest type is black spruce.

Class 7

Site Regions 7E and 6E - Sites in this class occupy extreme positions on the physiographic site classification and include bare rock areas and marshy areas of poorly decomposed peat.

Other Regions - Sites of this class at the lowest end of the productivity gradient are similar in the other regions. They are very shallow, fine sand over bedrock which is resistant to weathering or saturated sites of poorly decomposed peat. Poor open stands of dwarf jack pine or black spruce are associated with these sites.

TABLE 5

SUMMARY OF CAPABILITY CLASSES IN ONTARIO

Region	Clay			Loam				Silty fine sand				Coarse & medium sand				Organic wet	Rock dry
	Fresh	Moist	Wet	Dry	Fresh	Moist	Wet	Dry	Fresh	Moist	Wet	Dry	Fresh	Moist	Wet		
7E	1(2)	2(3)	4	2	1	2	3	3	2	2	4	4	3	3	4	4(6)	7
6E	1(2)	3	4	3	1	2	4	4	2	3	5	5	3	4	4(5)	4(6)	7
5E	2(3)	3(4)	5	3	2	3	5	4	3(2)	4	5	5	4	4	5(6)	5(6)	7
4E	3	4	5	4	3	4	5	5	4	5	6	5	5	5	6	6(7)	7
3E	4	5	6	5	4	5	6	5	5	5	6	5	5	5	6	7	7
5S	4(5)	2(3)	5	5(6)	4	3(2)	5	5(6)	4(5)	3(2)	5	5	4	3	6(5)	6(7)	7
4S	4	3	6	5	4	3	5	5	4(5)	4	6	5	4(5)	4(5)	6	6(7)	7
4W	4	3	5	6	4	3	5	5(6)	4	4	6	5(6)	4	4(5)	6	6(7)	7
3W	4(5)	4(5)	6	6	4	4	6	5	5(4)	5(4)	6	5	5	5	6	6(7)	7

1. Where two capabilities are given, the lower class may be due to the second limitation shown in Table 2; the higher class may be due to enrichment of telluric water of a mixing of mineral and organic materials in the upper soil layers or variations in the intensity of the limitations shown in Table 2 may result in a range of capabilities.

TABLE 6

DOMINANT LIMITATIONS OF CAPABILITY CLASSES IN ONTARIO

Region	Clay			Loam				Silty fine sand				Coarse & medium sand				Organic wet	Rock dry
	Fresh	Moist	Wet	Dry	Fresh	Moist	Wet	Dry	Fresh	Moist	Wet	Dry	Fresh	Moist	Wet		
7E	D	W	W	M	-	W	W	M	F	W	W	M	F	F(W)	W	W	R
6E	D	W	W	M	-	W	W	M	F	W	W	M	F	F(W)	W	W	R
5E	C(D)	W(D)	W	M(C)	C	W(C)	W	MF	F	WF	W	M	F	F(W)	W	W	R
4E	C2	W	W	M	C	W	W	M	F	W	W	M	F	F(W)	W	W	R
3E	C	W	W	M	C	M	W	M	F	W	W	M	F	F(W)	W	W	R
5S	M(L)	F	W	M(R)	M	C	W	M(R)	M(F)	C	W	M	M	M	W	W	R
4S	M	C	W	M	M	C	W	M	C(F)	F	W	M	C(F)	F(R)	W	W	R
4W	D	C	W	R	F	C	W	M(R)	F	F	W	M(R)	F	F(R)	W	W	R
3W	C(L)	C(L)	W	MR	C	C	W	M	M	C	W	MF	MF	F	W	W	R

2. The limitation "C" is used where there is no physiographic site feature other than climate significantly limiting production.

QUEBEC

M. Jurdant¹, J. Beaubien¹,
J.P. Dube², L. Carrier²

Capability Classes

The southern part of the Province of Quebec can be subdivided roughly into the following "Ecoregions", each characterized by a climatic forest association:

Ecoregion "A": sugar maple/basswood
Ecoregion "B": sugar maple/yellow birch
Ecoregion "C": balsam fir/yellow birch
Ecoregion "D": balsam fir/white birch
Ecoregion "E": balsam fir/black spruce

Table 5 summarizes the principal characteristics of the capability classes and describes typical forestland units.

Class 1

There are no lands in the Province of Quebec which belong to this class.

Class 2

The lands placed in this class are the best suited for tree growth in the Province. They are confined to Ecoregion "A" where the limitation is a slightly adverse regional climate. The soils are deep, medium textured, permeable, well to imperfectly drained, have good water-holding capacity and are naturally high in inherent fertility. They are

¹Canada Department of Forestry and Rural Development, Ste-Foy, Que.

²Department of Lands and Forests, Quebec, Que.

easily maintained in good productivity.

Class 3

Because of a moderately adverse regional climate, the lands placed in this class are best in Ecoregions "B", "C" and "D" where the soils are deep, permeable, medium textured, well to imperfectly drained and have a good water-holding capacity. In Ecoregion "A", Class 3 lands are usually associated with soils whose texture slightly affects the level of available nutrients or moisture, or with topographic positions that create somewhat impeded internal soil drainage.

Class 4

In Ecoregion "E", the moderately severe regional climate limits the capability of the best lands to Class 4 even though the soils are deep, permeable, medium textured, well to moderately well-drained and have a good water-holding capacity. In the other Ecoregions, the most frequent limitations, in decreasing order of importance, are:

- (1) shallowness of soil over bedrock;
- (2) deficiency of moisture caused by coarse-textured soils;
- (3) excess of moisture caused by heavy-textured soils or topographic position or both;
- (4) adverse local climate, such as exposure and poor air drainage;
- (5) low inherent soil fertility.

Class 5

The limitations of Class 5 include the adverse effects of one or more of the following factors. In decreasing order of importance, these factors are:

- (1) shallowness of soil;
- (2) excess of moisture;
- (3) deficiency of moisture;
- (4) adverse local climate;
- (5) low soil fertility.

Class 6

Shallowness of soils and excess of moisture are the two major factors limiting the forest capability in this class. Deficiency of moisture, adverse local climate, and low soil fertility, however, may also be important locally.

Class 7

Class 7 lands include extremely shallow soils over bedrock, very wet organic soils, inundated mineral soils, soils very high in toxic elements and lands with an extreme local climate.

Capability Subclasses

Climate

Regional Climate - The regional climatic limitation has no subclass designation because lands with other significant limitations within a given climatic region are all affected by the regional climate. In other words, absence of a subclass symbol means that the class is the highest for the region. Southern Quebec can be subdivided into three broad areas.

- (1) The first is an area where a slight regional climatic limitation limits the capability of the best lands to Class 2. This includes Ecoregion "A". It is confined to Section L-2 and L-3 of the St. Lawrence Lowlands, (Rowe 1959).
- (2) The second is an area where a moderate regional climatic limitation limits the capability of the best lands to Class 3. It is the most

TABLE 7. CAPABILITY CLASSES AND MAJOR SUBCLASSES IN QUEBEC

Capability Classes	Degree of Limitation	Productivity (merchantable M.A.I. cu ft/acre/annum)	Site Index ¹ at 50 Years	Ecoregion	Major Sub-Classes	Typical Examples of Forestland Units
1	None	111 +	—	—	—	—
2	Slight	91 — 110	61 +	A	Regional Climate	sugar maple/basswood on deep, moderately well-drained loamy soil (brown forest soil), St-Eustache, Que.
3	Moderate	71 — 90	51 — 60	A	M	sugar maple/red oak on deep, well-drained sandy loam till (brown forest soil), Oka, Que.
					W	sugar maple/elm on deep, imperfectly-drained sandy loam till (low humic gley), Papineauville, Que.
				B-C-D	Regional Climate	sugar maple/yellow birch on deep, moderately well-drained sandy loam till (minimal podzol), Lac Simon, Que.
4	Moderately Severe	51 — 70	41 — 50	A-B-C-D	R	sugar maple/yellow birch/ <i>viburnum</i> on shallow well-drained, sandy loam till (minimal podzol), Lac Simon, Que.
					M	balsam fir/red maple on deep, well-drained sandy outwash (humic podzol), Beauré, Que.
					W	balsam fir/cedar on imperfectly-drained loamy till (low humic gley), L'Islet, Que.
				E	Regional Climate	balsam fir/black spruce on deep, well-drained sandy loam till (humic podzol), Lac Jacques Cartier, Que.
5	Severe	31 — 50	31 — 40	A-B-C-D-E	R	balsam fir/black spruce on shallow well-drained, sandy loam till (humic podzol), Lac Jacques Cartier, Que.
					W	balsam fir/white birch/ <i>hylocomium</i> on imperfectly-drained sandy loam till (gleyed podzol), Stoneham, Que.
					M	black spruce/ <i>kalmia</i> on deep, well-drained sandy outwash (podzol), Lac Jacques Cartier, Que.
6	Very Severe	11 — 30	21 — 30	A-B-C-D-E	R	balsam fir/white birch/ <i>hypnum</i> on granitic bedrock (Ranker), Riviere des Neiges, Que.
					W	black spruce/ <i>kalmia</i> / <i>sphagnum</i> on poorly-drained, sandy outwash (peaty gleyed podzol), Riv. Chicoutimi, Que.
					M	black spruce/ <i>kalmia</i> / <i>cladonia</i> on excessively-drained, gravelly outwash (ortstein podzol), Lac Jacques Cartier, Que.
7	Non-commercial	0 — 10	0 — 20	A-B-C-D-E	W	black spruce/ <i>sphagnum</i> / <i>ledum</i> on very poorly-drained soils (oligotrophic peat), Riv. Chicoutimi, Que.
					R	black spruce/ <i>kalmia</i> / <i>cladonia</i> on granitic bedrock (Ranker), Petit Saguenay River, Que.

¹These figures are tentative and should be used only as indicators of productivity. They are not intended to replace the volume data, but rather to aid the indirect evaluation of the productivity where no "normal" stands are available.

extensive, comprises Ecoregions "B", "C", and "D", and covers most of Sections L-4, L-5, and L-6 as well as a large part of the Boreal Forest Region below 2,500 feet.

- (3) The third is an area where a moderately severe regional climate limits the capability of the best lands to Class 4. It includes Ecoregion "E" and is confined to those areas of the Boreal Forest Region above 2,500 feet.

Local Climate - Subclasses are used when a significant departure from the median climate of the region has an adverse effect on the forest capability of lands.

- H - This limitation has not been observed extensively in Quebec, but it may have some importance in the Appalachian areas where there are extensive lowlands with poor air drainage.
- U - Wind exposure seems to be of considerable importance in the Gaspé Peninsula; it can downgrade the capability by one to four classes.

Soil Moisture

- M - This limitation is very extensive in Quebec, but the importance increases from east to west on soils in the same drainage class. For example, in Ecoregion "B", well-drained, medium-textured tills have a lower forest capability in the Gatineau area than in the Quebec area; differences in summer rainfall might well be the explanation. Compared to lands in the same Ecoregion which do not have this limitation, the following general rules might apply.
 - (1) Soils moderately affected by droughtiness should be downgraded by one class.
 - (2) Soils severely affected by droughtiness should be downgraded by two classes.
 - (3) Soils very severely affected by droughtiness should be downgraded by three classes.
- W - This is the second most important limitation in Quebec. Compared to lands in the same Ecoregion which do not have this limitation (soils belonging to the optimum drainage class) the following general rules might apply.
 - (1) Soils one drainage class lower than optimum should be downgraded one or two classes.
 - (2) Soils two drainage classes lower than optimum should be downgraded by two or three classes.
 - (3) Soils three drainage classes lower than optimum should be downgraded by three or four classes.

- (4) Soils four drainage classes lower than optimum should be downgraded by four classes.

Permeability and Depth of Rooting Zone

- D - The occurrence of fragipan is the only condition where this limitation may apply in Quebec. Fragipan might downgrade the capability by one class on the well and moderately well-drained soils.
- R - This is by far the most important limitation in Quebec. Compared to lands in the same Ecoregion which do not have this limitation, the following general rules might apply.
- (1) Less than 3 feet of soil over bedrock should be downgraded by one or two classes.
- (2) Very shallow soils or bedrock outcrops should be downgraded by three or four classes.

Soil Fertility and Toxicity

- F - This limitation rarely occurs singly. It is rather used in combination with subclasses "M" or "W".
- N - The only lands affected by this limitation are the serpentine areas of the Gaspé Peninsula, where the capability class is 7.

Inundation

- I - This limitation was not observed in the areas that have been mapped, but it may have some importance along the St. Lawrence River and in Abitibi.

Summary

At this stage of the Canada Land Inventory program in the Province of Quebec, it is impossible to give a complete description of all the land capability units. An attempt has been made, however, to describe the capability classes and subclasses that have been observed in the areas that have been mapped. Table 6 gives a first approximation of the classification on the basis of experience to date. Although a wider variety of sites may be encountered in Quebec, Table 8 should give some indication of the most common forestland units in the Province.

TABLE 8. FORESTLAND CAPABILITY CLASSES AND SUBCLASSES IN QUEBEC

Broad Classes of Soil Parent Materials	Eco-region	Soil Drainage Classes								
		Very well-drained	Well-drained	Moderately well-drained	Internally-drained (seepage)	Internally-drained	Poorly-drained (seepage)	Poorly-drained	Very poorly-drained (seepage)	Very poorly-drained
Fine-textured Soils	A	(1)	2	2	2	4W	4W	(1)	(1)	7W
	B	(1)	(1)	(1)	4W	4W	4W5W	5W	6W	7W
	C	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
	D	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
	E	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Medium-textured Soils	A	4M	3M	2	2	3W	(1)	(1)	(1)	(1)
	B	4M	3-4M	3	3	4W	4W	5W	6W	7W
	C	4M	3	3	3	4W	5W	6W	6W	7W
	D	4M	3	4W	4W	5W	5W	6W	6W	7W
	E	5M	4	4	4	5W	5W	6W	7W	7W
Coarse-textured Soils	A	4MF	3MF	3F	3F	3W	4W	5W	6W	7W
	B	5MF	4MF	3	3	4W	4W	5W	6W	7W
	C	5MF	4MF	3	3	5W	5W	6W	6W	7W
	D	5MF	4MF	4MF	4W	5W	5W	6W	6W	7W
	E	6MF	5MF	5MF	5W	5W	5W	6W	7W	7W
Shallow Soils over Bedrock	A	5RM	4R	(1)	(1)	(1)	(1)	(1)	(1)	7W
	B	5RM	4R-5RM	4R	4W	4W	5W	5W	6W	7W
	C	5RM	4R	4R	4W	5W	5W	6W	6W	7W
	D	5RM	4R	4R	4W	5W	5W	6W	6W	7W
	E	6RM	5R	5R	5W	5W	5W	6W	7W	7W
Bedrock	A	7RM	6R	5R	(1)	(1)	(1)	(1)	(1)	(1)
	B	7RM	6R	6R	(1)	(1)	(1)	(1)	(1)	(1)
	C	7RM	6R	6R	(1)	(1)	(1)	(1)	(1)	(1)
	D	7RM	6R	6R	(1)	(1)	(1)	(1)	(1)	(1)
	E	7RM	6R	6R	(1)	(1)	(1)	(1)	(1)	(1)

(1) Not observed in the areas that have been mapped.

MARITIMES

W.D. Holland¹

Capability Classes

The whole region is characterized by cool, short, growing seasons and marked effects of exposure, especially in coastal areas and at high elevations. Precipitation has a limiting effect on forest growth in only a few areas, namely on some very coarse soils or very steep slopes where surface run-off is rapid. Soil survey data show that low levels of soil fertility are characteristic of the region. The limitation of low fertility is even greater for those areas designated with the symbol "F". In some instances, however, the symbol has also been applied to apparently good soils where no reasons other than the low regional fertility level, or some climatic limitation are apparent.

Class 1

No areas of Class 1 have been mapped in the Maritimes. Although data have indicated Class 1 productivity in a few isolated instances, this has been the result of peculiar combinations of site factors that are not characteristic, and which, for practical purposes, may be ignored.

Class 2

Very little Class 2 forestland has been mapped in New Brunswick, practically none in Nova Scotia, and none in Prince Edward Island. Where

¹Canada Department of Forestry and Rural Development, Fredericton, N.B.

found, it occurred on protected sites on lower slope positions. Soil textures were loamy sand to sandy loam. External and internal soil drainage was good. Available moisture appeared to be adequate. Except for a favoured physiographic location, these soils did not exhibit any marked differences from adjacent soils. Restriction to growth was considered to be due to regional climate and possibly to low soil fertility. In some instances, the measured species (larch or jack pine) were naturally better adapted to the site. The symbols 2F and 2FD were used. Since more lands in this category may be encountered in northwestern New Brunswick, the class can be better defined at that time.

The small amount of Class 2 land found in Nova Scotia cannot be adequately described at this time.

Prince Edward Island has no Class 2 forestland. Despite many of the Island's soils being sandy loam and loamy textures, friable and deep, laboratory data indicate very low cation exchange capacities and a low base saturation, which together with severe exposure exclude the soils from this class.

Class 3

Class 3 land was encountered infrequently on a wide range of soil series in all three Maritime Provinces, usually in protected locations on lower slopes or in slightly depressional valley bottoms, and occasionally associated with telluric sites. Regional climate and soil fertility limitations were assigned.

The most widely used symbol in New Brunswick was 3F, and occasionally 3_F^U , 3_M^F , 3_W^F , 3_D^U , 3D and 3_D^F . These lands were usually

associated with the better soils located at some distance from coastal areas. In this context better soils are defined as, "soils on till derived from rocks containing some calcium carbonate in the cementing material", and, "stratified, well-sorted, sandy deposits usually found on river slopes and terraces and on some former flood plains"¹ (e.g. Saltspring, Parleeville, Knightville, Riverbank, and Kennebecasis soil series). Also included are those soils, "developed on till from predominantly non-calcareous rock material"², which are strongly aggregated and provide a good medium for root growth (e.g. the Petitcodiac series). Much of the Class 3 land was mapped as part of a complex with Class 4. The lands in this class in New Brunswick supported jack pine stands whose heightage relationships tend to give higher productivity measures than red spruce.

In Nova Scotia, the small areas of land in this class were found on almost any soil series, but generally in protected sites, as in New Brunswick. It was mapped mostly as a minor component of complexes with Classes 4,5, and 6. Some of the better alluvial soils (e.g. the Cumberland series) were mapped entirely as Class 3 and the symbol 3F was used almost exclusively.

On Prince Edward Island, Class 3 lands occur infrequently in small areas in protected valleys - the limitations again being regional climate and soil fertility - but are too small to be indicated on the maps. Certain sandy loam soils in south Kings County and southeastern Queens County might be rated as Class 3 for red or white pine. The water table occurs at approximately three feet and deeper-rooted pines may make better

¹H. Aalund and R.E. Wicklund. Soil Survey Report of Southeastern New Brunswick, 1949.

use of it than shallow-rooted spruce. The high winds that are characteristic of the Island may restrict these soils to Class 3.

Class 4

This is the modal class mapped in the region to date. It occurs on nearly all soil series, except some of the extremely coarse or very fine-textured soils and those subject to greater exposure than average for the region. Well-drained soils are characteristic. Soil textures are sandy loams and some of the well-structured clay loams. The soil profile seldom exceeds 16 to 18 inches in depth. In addition to the regional limitations of climate and soil fertility, compaction or dense subsoil horizons limits water and root penetration, and the symbol 4D was used extensively in New Brunswick - frequently with "F" and "U" - and occasionally with "W".

In Nova Scotia the symbols 4_{F}^{U} and 4_{U}^{F} were used predominantly. The "D" symbol for compaction was used infrequently, as were 4_{I}^{F} , 4_{X}^{F} , 4_{W}^{U} , 4_{M}^{I} , and 4_{H}^{F} .

In Prince Edward Island the class occurs on sandy loams to fine sandy loams, medium to well-drained, with moderate to fairly steep slopes; included are the Charlottetown, Alberry, the drier Culloden and Dunstaffnage, and some of the O'Leary clay loam soil series. The Culloden and particularly the Dunstaffnage soils are coarse and well to excessively drained, but the water table lies at about three feet for at least part of the year. Thus moisture is available for tree growth, but not for shallow-rooted field crops. These soils are rated low for agriculture, and farm use is decreasing. Most of the soils in this class are found in Queens County, with small areas in Prince County. A large proportion of the land was mapped

as 4F, with frequent use of 4_M^F . A regional climatic limitation to growth is again assumed. The effects of exposure to frequent high winds are most noticeable near the coast and the more level lands of Prince County, and least noticeable inland in protected valleys of the central and southeast.

Class 5

Large areas of land in the Maritimes are in this class; in New Brunswick the area is nearly as extensive as that of Class 4. The regional limitations of climate and low soil fertility predominate. Included are the extremely coarse and extremely fine-textured soils, as well as areas at higher elevations where the effects of exposure are greater.

Excessive moisture in low depressional areas where soil drainage is impeded by dense subhorizons, or by the less permeable clays and clay loams, is one of the main limitations. The more common symbols used in New Brunswick were 5W, 5D, and 5U. Other symbols were 5_F^M , 5_M^U , 5_F^W , 5_F^U , 5F, 5_X^U , 5X, and 5_R^U .

In Nova Scotia the class is more common than in New Brunswick. The symbols were similar, but "D" was used less frequently and 5_F^U more frequently. Other symbols are 5_R^U , 5_H^F , 5_H^W , 5_I^W , 5_W^D , and 5_W^R .

In Prince Edward Island, Class 5 lands are associated with excessively-moist, clay loams of the O'Leary and Egmont series, and the exposed Charlottetown, Alberry and associated soils near the coast. It is also found on some of the Culloden and Dunstaffnage soils where soil moisture is inadequate for optimum tree growth. Much of the windward side of Prince County, the Gulf shore of Queens County and northern Kings County is included because of exposure.

Class 6

The severe limitations to growth are usually excessive wetness, but include some areas of shallow, dry soils on very steep, eroded slopes. The most common symbol used in New Brunswick was 6W but 6_X^U , 6_F^U , 6_M^U , 6_D^W , 6_U^W , and 6_R^U were also common.

In Nova Scotia, additional symbols used were 6_R^W , 6_R^M , 6_F^I , 6_W^F , 6_F^X , 6_D^U , and 6_F^R , thus indicating the presence of more shallow soils.

In Prince Edward Island 6W, 6_W^U , and 6_F^U indicated severe limitations to growth caused mainly by excessive soil wetness. Some of the coastal areas were rated because of their exposure as 6_F^U . The symbol 6_M^U was also used.

Class 7

These areas have little or no tree growth because of the preponderance of peat bogs and salt marshes. A few rocky outcrops and rock ledges are included. In New Brunswick the most common symbol, 7W, was applied to the peat bogs. The symbol 7_I^W was applied to the salt marches, or marshland soils which, generally, are fine textured, contain a high salt content and, when not protected by dykes, are subject to tidal inundation. Even when dyked, many of the marshland soils are poorly drained. A few small areas of 7R and 7_R^U were mapped as part of complexes where bedrock was at or near the surface. The symbol 7_F^R applied to areas denuded by strip-coal mining, and the symbol 7_M^U to some of the sand dunes on coastal sand bars.

In Nova Scotia the symbols 7_W^R and 7W were used extensively; the latter applied to very wet peat bogs. The 7_W^R indicates complexes of

dry, rocky land with very thin sola above bedrock, and areas of extreme wetness. Other symbols were 7_F^I , 7_F^U , 7_I , 7_F^W , 7_F^U , 7_U^R , 7_X , and 7_F .

Class 7 lands in Prince Edward Island generally result from extremely poor drainage and exposure to sea winds. Armdale soils, windswept sand bars and beaches, and salt marshes subject to periodic inundation were included. The symbol 7_X^U was used quite frequently, along with 7_M^U , 7_I , 7_X , 7_W , and 7_F^U .

Capability Subclasses

Climate

The symbols indicate departures from the median regional climates. Subclasses "A", "C" and "H" were not used in New Brunswick. Subclass "H" was rarely used in Nova Scotia. "U" was used very extensively.

Soil Moisture

Subclass "M" was used to indicate a deficiency of soil moisture, usually in the coarser-textured soils, or on steep slopes where surface run-off is very rapid. It was used more extensively in Nova Scotia than in New Brunswick. In Prince Edward Island, "M" was associated with the coarser-textured soils, mainly in the southeastern part of the Province.

The symbol "W" applied to excessively-wet soils of the region. These may have inadequate internal drainage, high water tables or, occasionally, seepage. Excessive wetness is one of the main limiting factors of forest growth in the mapped area of the region. The symbol was used extensively and is one of the most accurately mapped limitations.

"X" was used occasionally where the scale of mapping did not permit separation of complex patterns of "M" and "W".

Permeability and Depth of Rooting Zone

"D" was used very extensively, particularly on soils developed from glacial tills and of mixed morphology - for example, marine sandy sediments overlying clay deposits. The symbol was also used where the subsoils were harsh, compacted, and intractable, permeability and consistency being the primary considerations. It was used less frequently in Nova Scotia than in New Brunswick and not at all in Prince Edward Island.

In New Brunswick, "R" was employed to indicate bedrock within a foot of the surface primarily to indicate a series of long, narrow ridges and the loose, broken and relatively unweathered rock at the surface in strip-mining areas. The symbol was used frequently in Nova Scotia, particularly with "W", but not in Prince Edward Island.

To date, "Y" has not been used in the Maritime Region.

Soil Fertility or Toxicity

"F" was used in two ways in New Brunswick - to denote an additional limitation for Classes 2 and 3, where only regional climate was obvious; and to indicate a lower fertility status than is average for the region for Classes 4,5, and 6. Lack of data made this subclass difficult to apply. It was used very extensively in Nova Scotia.

Frequent use of "F" in Prince Edward Island indicates that low inherent soil fertility levels impose severe limitations to growth.

It is doubtful whether "L" will be used in this region.

"N" has been used only for the salt marshes and marshland soils. When these soils are not protected by dykes, frequent tidal inundation, high

salt content and wetness preclude their use for forestry. When the marshlands are protected by dykes and are adequately drained, they may have greater value for agriculture than for forestry.

There is insufficient evidence of toxicity resulting from high aluminum or iron content in the soil to justify their representation by the symbol "N".

Stoniness

The symbol "P" was rarely used in New Brunswick, and not at all in Nova Scotia or in Prince Edward Island.

Inundation

"I" was used extensively on the marshland soils and on some of the streams having active floodplains. In the latter instance, many areas are too small and narrow to show at the scale of mapping.

NEWFOUNDLAND

K. Beanlands¹ and A.W.H. Damman²

In Newfoundland, there are two conditions as follows where fire may cause, or has caused, a change of more than temporary nature in capability.

- (1) Rock piles and bedrock covered with a raw humus layer may show a fairly good productivity if seepage water flows through the rock piles or over the bedrock. A fire which removes the raw humus layer, however, will change these sites to unproductive forestland.
- (2) Fire on some of the nutrient-poor sites may lead to the formation of a *Kalmia* heath if tree regeneration fails to become established within a few decades. Once a *Kalmia* heath has occupied these sites for more than about 100 years, there is little likelihood of natural reforestation owing to the accumulation of a very thick ericaceous mor layer on all but the very driest of these sites.

Such areas have been rated according to their present productivity in both cases. The latter condition is now common in the eastern and southern parts of Newfoundland.

So far, the land capability survey has been confined to Central Newfoundland. For the purpose of this report, the forest types for the remainder of the Island have been placed into capability classes using data obtained in other studies by Damman and adapted to the Canada Land Inventory on the basis of experience gained in the central region.

¹Newfoundland Department of Mines, Agriculture and Resources, St. John's, Nfld.

²Canada Department of Forestry and Rural Development, St. John's, Nfld.

Capability Classes

Class 1

There are no Class 1 lands in Newfoundland.

Class 2

Mature forest stands on this land contain over 65 cords per acre¹. This is the highest capability class found in Newfoundland and occurs only locally in the western and central parts of the Island. The undisturbed forests of this class consist largely of balsam fir in mixture with birch and white spruce.

These sites have no limitations to forest growth other than regional climate. The soils are deep, well-drained to somewhat poorly-drained loams². Competition, especially of alder and mountain maple, is often a problem after logging, and birch forest usually occupy these soils after fire; thus stands on these sites often have a productivity below their capability.

Class 3

Mature stands on this land may contain 50 to 65 cords per acre. The soils represent the most productive sites on the major part of the Island, and their productivity is limited only by adverse regional climate

¹While volume at rotation age was not used for determining the capability class, it has been mentioned here to give a better impression of the forests included in the classes. A conversion factor of 85 cubic feet/cord has been used to arrive at these figures.

²The drainage classes are those defined in the Soil Survey Manual, USDA Handbook 18, Govt. Printing Office, Washington, D.C. 1951.

or by slight limitations of wetness, fertility, and droughtiness which do not affect the class level.

On Class 3 land, the limitations to tree growth are moderate. They are commonly wetness and fertility, and less often coarse texture and low water-holding capacity of the parent material. The undisturbed forests are balsam fir in mixture with white birch and white spruce.

The soils are usually deep, and imperfectly-drained to well-drained. The class occupies fairly extensive areas on both well-drained and imperfectly-drained soils on nutrient-rich loamy parent materials; on nutrient-poor and lighter-textured parent materials, it is generally restricted to the imperfectly-drained lower slopes.

Competition by alder and mountain maple can be a problem after logging or windthrow; many of these soils are often occupied by birch forests after a fire.

Class 4

Mature, fully-stocked stands on this land contain 35 to 50 cords per acre. A large part of the productive forestland of the Island falls into this class, except in the exposed eastern parts of the Island where Class 4 is confined to the more protected valleys and inland areas. The undisturbed forests consist of balsam fir, often with some birch and white spruce.

These sites have moderate to severe limitations in soil conditions; the most common are nutrient-poor soils, wetness, bedrock, or very compacted basal till about one foot down in loams and silt loams. Many of the slope soils have bedrock or basal till within two feet; this is not a

limiting factor however, since it promotes seepage along the slope, and thus often increases productivity.

The soils are moderately well-drained to poorly-drained, and vary greatly in depth. Commonly included are the long slopes in nutrient-poor parent materials, the poorly-drained part of the slopes on nutrient-rich parent materials, and the dense calcareous silt loams of the limestone tills with bedrock at one to two feet.

Most of the forests reproduce excellently after logging. Fire converts the majority into very productive black spruce forests. Shrub competition prevents adequate regeneration only in some wet pockets on nutrient-rich or calcareous till.

Class 5

Well-stocked mature stands contain 20 to 35 cords per acre. The class includes both poor forests and those considered to be moderately productive.

The soils exhibit severe limitations to forest growth. A great variety of limiting factors, or combinations, can result in this capability class. Excessive stoniness, low water-holding capacity of the soil, and excessive wetness are the most common, often in combination with low fertility. On peninsular areas of the east coast, exposure can also reduce many soils to this capability.

Because of their great variety, it is difficult to describe, in general terms, all the soil conditions. The class typically occupies large areas of rocky, nutrient-poor, till soils with an undulating or irregular topography; the hill-tops and very steep slopes in poor and

moderately poor till areas; slopes; and the poorly to very poorly-drained parts of almost all deposits. Class 5, however, is confined to those organic soils which are enriched by seepage water. Only areas capable of supporting closed forest stands are included.

Most of the undisturbed forests are balsam fir/black spruce or black spruce. Competition by shrubs presents a problem only on the nutrient-rich and wet sites. Ericaceous dwarf shrubs hinder regeneration on the poorly and imperfectly-drained, nutrient-poor soils. The moderately well-drained and well-drained soils usually reproduce satisfactorily; repeated fires without an adequate seed supply eventually result in dwarf shrub invasion. Fire may have disastrous effects on some of the excessively rocky and stony soils; if it removes the organic horizon covering the boulders and bedrock, it will reduce the land capability to Class 7.

Class 6

Mature forest stands contain from 7 to 20 cords per acre. The soils offer very severe limitations to tree growth. Sometimes it is due to extreme limitation by one factor such as wetness, regular flooding, or rockiness, but in general it is the result of a combination of factors.

The class includes a great variety of conditions and no general description of the soil can be given. It includes both excessively dry and wet soils at all fertility levels. Most common in this class are forests on humus covered bedrock and rock piles, bog and bog-border forests, fen forests, and dwarf shrub/black spruce forest. Exposure to wind can reduce any soil to this capability; thus it is common in the exposed barrens of eastern and southern Newfoundland, near the seashore and at higher altitudes.

The forests are always open stands in which black spruce, and sometimes larch, are the most important tree species. Regeneration is generally difficult, either because of a lush herbaceous or shrub vegetation on the nutrient-rich, wet soils, or the abundance and vigor of ericaceous dwarf shrubs.

Class 7

These lands are either unsuitable for tree growth or support scrubby or very open stands of about 5 cords per acre at maturity.

The limitations are so severe that the sites are completely unproductive from a forestry point-of-view. The most common limiting factors are wetness, rockiness or stoniness, regular flooding, or extreme exposure to wind. Also included are the serpentine areas, the soils of which, owing to their high magnesium content, are unsuitable for most plant growth.

The *Kalmia* heath of the eastern and southern parts of the Island are included. They differ from the other sites in this class in that most of them have once supported forests. Soil degradation, raw humus accumulation and severe exposure now prevent natural reforestation.

Capability Subclasses

Certain assumptions concerning limiting factors were made which may have important consequences on the interpretation of the results.

Bedrock near the surface is a limitation since it restricts root development and thus nutrient and moisture supply to the tree. If nutrient-rich seepage water flows over the bedrock, however, productivity may increase. Here the bedrock can hardly be shown as a limitation, although it is very

much in evidence. On the other hand, if stagnant water on the bedrock surface leads to reduced productivity, *wetness* has been used as the limiting factor rather than *bedrock*.

The ecological effect of soil water on forest productivity is very complex. Increased wetness decreases aeration of the soil, thus hampering root development and reducing the capability of a soil. Ground water is often rich in nutrients, however, and seepage water can be both nutrient-rich and allow a satisfactory aeration of the soil. In these circumstances particularly on the nutrient-poor parent materials, increased wetness may actually result in increased productivity. Thus, for many areas with imperfectly or somewhat poorly-drained soils, *fertility* rather than *wetness* was used as a limiting factor. In general, wetness was used as a limiting factor only if the capability of the soil was reduced below that of comparable, well-drained soils.

Climate

Newfoundland has a cool, humid climate; therefore there are no limitations caused by aridity or temperature.

"C" was used for limitations caused by a combination of adverse climatic factors. Included in this subclass are soils with no limitations other than climate, or soils for which other limitations are of a minor nature and do not affect the class level. If there were limiting factors in addition to climate, they determine the subclass; thus "C" has never been used in combination with other subclasses.

"U" was used when there is a loss of productivity owing to excessive exposure to wind. It was used at a sub-regional level along the

south coast, on the exposed eastern peninsulas, and on the high uplands. It was commonly employed at a local level to designate growth reduction on exposed hill-tops and in the immediate vicinity of the sea coast in all parts of the Island. The limitation appears alone, or in combination with almost any other factor when the site did not reach the potential productivity of comparable, but sheltered, areas of the same region. If exposure resulted in a capability class of 6 or 7, however, other limiting factors were usually omitted.

Soil Moisture

Productivity can be affected by both a deficiency and a surplus of soil moisture. In addition, some soils are characterized by alternate wetting and drying. Since no subclass is recognized to accommodate this limitation, and since wetness rather than drought is the dominating characteristic of these soils, they were included in the *wet* subclass. In Newfoundland, soils that are alternately wet and dry always have a stagnant, perched water table.

"M" was used for soils on which productivity is limited by drought caused by a low water-holding capacity of the soil rather than by the climate. It is often associated with low nutrient levels. The subclass was used for the following conditions.

- 3M - Soils on which productivity is slightly affected by drought - nutrient-rich, sandy loams and loamy sands in areas where Class 2 can occur on well-drained to moderately well-drained loams.
- 5MF - Soils with reduced productivity because of both drought and low fertility, the former being the principal factor - somewhat excessively-drained loamy sands or silty sands.
- 5FM - Soils with reduced productivity because of both low nutrient content and low water-holding capacity, well-drained to somewhat excessively-drained, nutrient-poor sandy loams and loamy sands.

- 6M - Soils with greatly reduced productivity because of low water-holding capacity - excessively-drained sandy soils usually of glacio-fluvial origin.
- 6MD - Similar to 6M but with cementation in B or C horizon.
- 7M - Completely unproductive soils on excessively-drained, often gravelly, coarse and medium sands which are usually of glacio-fluvial origin. The symbol was used only in the climatically driest parts of the Island.
- 7MD - Similar to 7M, but with cementation in B or C horizon.
- 7MU - Coastal dune sands.

"W" was used for soils where excess water, other than flooding, limited the productivity. This can result from a high water-table, a stagnant, perched water-table or seepage water. The effect of these three types of water on soil capability is very different. Wetness caused by a stagnant, perched water-table always reduces productivity. Ground water, and especially seepage water, however, may have beneficial effects which offset the damaging effects of the high water-table. The subclass was used for the following conditions.

- 3W - Soils on which productivity is slightly decreased by excess water - imperfectly-drained to poorly-drained soils on nutrient-rich parent material in areas where Class 2 is the optimum.
- 4W - Poorly-drained soils on nutrient-rich parent materials where growth is reduced by excess water.
- 5W - Poorly and very poorly-drained soils on nutrient-rich parent materials and very poorly-drained soils with nutrient-rich telluric ground or seepage water on nutrient-poor parent materials.
- 5WF - Very poorly-drained bog borders still influenced by minerogenic water - usually on mucky peat (mesisols) or on mineral soils with a peaty surface horizon.
- 6W - Permanently-wet, nutrient-rich soils - fens, mountain maple and alder swamps with an open tree cover, muck soils (humisols) and wet, mineral soils with a mucky, organic horizon.
- 6WF - Similar to 5WF, but with more extreme wetness, thus reducing the capability to Class 6.

- 6FW - Poorly or very poorly-drained bog borders seldom influenced by minerogenic seepage water, and similar soils in valleys and flat areas with a stagnant perched water-table - usually peat soils (fibrisols) or mineral soils with a peaty, organic horizon.
- 7W - Treeless alder and willow swamps which are not flooded by rivers - usually muck soils (humisols).
- 7FW - Treeless bogs and conditions similar to 6FW but with lower capability.

"X" indicates an intimate pattern of subclasses "M" and "W" where the components could not be mapped individually. It was used only for the soils of the barrens. In most cases, fertility is also limiting productivity, although it was not included in the subclass symbol. The subclass was used for the following conditions.

- 7X - Soils which have supported forests varying in capability from Class 4 to 6, but which have been altered to such an extent by the occupation of ericaceous dwarf shrubs that they will not regenerate naturally. It includes presently unproductive soils which, on the well-drained and moist sites, are covered with one to one and a half feet of raw humus developed under the ericaceous dwarf shrub vegetation. On the poorly-drained sites, these soils are covered with peat moss. In the more extensive areas in which the symbol was used, the removal of the forest has also resulted in severe wind exposure.
- 7UX - Similar to 7X, but including the severely-exposed sites which have never had a capability higher than Class 7.

Permeability and Depth of Rooting Zone

"D" was used to indicate limitations caused by compaction or cementation. Fragipan was never considered to be a limiting factor, since in Newfoundland its beneficial effects on moisture and nutrient regimes far outweigh the effects on root development. The subclass was used for the following conditions.

- 4D - Indicates a very strongly compacted basal till at one to two feet overlain by silt loam. The condition was only encountered in the calcareous till areas where the effect of the basal till was very similar to that of a bedrock surface nearby.

- 5D - Similar to 4D, but with strongly compacted basal till within one foot of the mineral soil surface.
- 6MD - Similar to 6MD in subclass "M".
- 7D - Compacted calcareous basal till at the surface covered with an ericaceous mor layer.
- 7MD - Similar to 7MD in subclass "M".

"R" includes soils where bedrock near the soil surface reduces productivity. It was considered a limitation only if productivity was reduced below the level of comparable, deep soils. Generally, it has to be within two feet of the soil surface to be significant. Shallow soils over bedrock are rarely uniform in depth owing to the irregularity of the bedrock surface, but the variability is greatest in limestone areas. Consequently, the depth classes indicated below refer to the predominant depth of the bedrock below the ground. The subclass was used for the following conditions.

- 4R - Somewhat poorly-drained to moderately well-drained calcareous silt loams with limestone bedrock at a depth of one to two feet.
- 5R - Shallow soils of various origin. It includes somewhat excessively-drained, sandy loams and loamy sands with bedrock of various origins at a depth of one to two feet, and moderately well-drained to somewhat poorly-drained loams and silt loams of a depth of less than one foot over shale and limestone.
- 6R - Very shallow soils, in most places with a raw humus layer directly over the bedrock and pockets of mineral soil locally. Found on all types of bedrock except serpentine.
- 7R - Bare bedrock or covered only with raw humus, without tree cover or with scrubby black spruce forest. Found on all types of bedrock except serpentine.

Low Soil Fertility or Toxicity

These limitations are caused by a lack of available plant nutrients or the occurrence of an element in such concentrations that it is toxic to tree growth.

"F" was used for soils with low inherent fertility. The subclass was used for the following conditions.

- 3F - Imperfectly and poorly-drained soils in parent materials of low fertility, where moisture improves the nutrient status of the soil. This subclass was recognized only in areas having Class 2 soils and where the well-drained soils on the same parent material have a capability of Class 3 or lower, but most often Class 5FM.
- 4F - Imperfectly to moderately well-drained soils on parent materials of low fertility. This was recognized wherever the well-drained soils on the same parent material had a capability of Class 4 or lower, but usually Class 5FM. Below Class 4, fertility was always used in combination with dryness or wetness. They have been described under subclasses "M" and "W", respectively.

"N" was used for the soils of the serpentine areas which are characterized by a very high magnesium content and which can be tolerated by a relatively small number of plants. These areas have very sparse vegetation and are completely devoid of trees. The subclass was used for the following two conditions.

- 7N - Serpentine till and outwash soils, often rocky at the surface because of severe frost heaving and polygon formation.
- 7NR - Serpentine rock barrens, rubble fields, and talus.

Stoniness

"P" was used for stoniness which does not greatly affect tree growth unless stones make up the greater part of the solum. It was used as a limiting factor only in extreme circumstances. The subclass was used for the following conditions.

- 5P - Soils with over 75 per cent stones covered with an organic horizon and with some water seeping through the stone piles - usually on steep slopes.
- 5PW - Wet soils with over 75 per cent stones covered with a peaty or mucky organic horizon - usually in valleys, flats, and depressions on the slopes.

- 6P - Dry soils with over 75 per cent stones, generally on knolls and hill-tops.
- 6PW - Similar to Class 5PW, but wetter or with fewer nutrients in the water.
- 7P - Unforested talus and scree slopes, or rubble fields.

Inundation

"I" includes soils intermittently flooded by streams and lakes. The less frequently flooded alluvial soils usually support an alder thicket with scattered excellent trees. Under management these sites could support forests of Class 3 or Class 4, but the competition from the alders is so severe that a closed forest will not establish itself until the soils become so much drier that the alder vegetation cannot maintain itself. The subclass was used for the following conditions.

- 6I - Moist alluvial soils with alder thickets and scattered trees; flooded only in spring and at other times of extremely high water levels.
- 7I - Regularly flooded soils along rivers and lakes with strongly fluctuating water levels; these soils support an alder, willow or marsh vegetation.

